AD-A159 939

(2)

INSTALLATION RESTORATION PROGRAM

PHASE I - RECORDS SEARCH

AIR FORCE PLANT NO. 3

TULSA, OKLAHOMA

PREPARED FOR

UNITED STATES AIR FORCE
HQ AFESC/DEV
Tyndall AFB, Florida
and
HQ ASD/PMD
Wright Patterson AFB, Ohio

DECEMBER 1983

ENGINEERING-SCIENCE

PII Redacted

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

A159939

1a. REPORT SECURITY CLASSIFICATION
Unclassified

1b. RESTRICTIVE MARKINGS
None

2a. SECURITY CLASSIFICATION AUTHORITY
None

2b. DECLASSIFICATION/DOWNGRADING SCHEDULE
N/A

3. DISTRIBUTION/AVAILABILITY OF REPORT
Unlimited

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

4. PERFORMING ORGANIZATION REPORT NUMBER(S)
None

5. MONITORING ORGANIZATION REPORT NUMBER(S)
None

6a. NAME OF PERFORMING ORGANIZATION
Engineering-Science

6b. OFFICE SYMBOL *(If applicable)*
N/A

7a. NAME OF MONITORING ORGANIZATION
ASD/PMDA

6c. ADDRESS *(City, State and ZIP Code)*
57 Executive Park South, Suite 590
Atlanta GA 30329

7b. ADDRESS *(City, State and ZIP Code)*
Wright-Patterson AFB
Ohio 45433-6503

8a. NAME OF FUNDING/SPONSORING ORGANIZATION

8b. OFFICE SYMBOL *(If applicable)*
ASD/PMDA

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
F08637-83-G-0005-SC01

8c. ADDRESS *(City, State and ZIP Code)*

10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
78011F			

11. TITLE *(Include Security Classification)*
Installation Restoration Program, Phase I - Records Search, AF Plant 3, Tulsa OK

12. PERSONAL AUTHOR(S)
N/A

13a. TYPE OF REPORT
Final Phase I

13b. TIME COVERED
FROM ______ TO ______

14. DATE OF REPORT *(Yr., Mo., Day)*
December 1983

15. PAGE COUNT
147

16. SUPPLEMENTARY NOTATION
None

17. COSATI CODES

FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
IRP

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*
This report provides an introduction, description, and environmental setting of Air Force Plant 3. It reviews past and present practices of waste storage, fuels management, spills, on-site treatment disposal methods, and surface impoundments. It recommends Phase II monitoring for 3 sites at AF Plant 3.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT
UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS ☐

21. ABSTRACT SECURITY CLASSIFICATION
Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL
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513-255-4466

22c. OFFICE SYMBOL
ASD/PMDA

DD FORM 1473, 83 APR — EDITION OF 1 JAN 73 IS OBSOLETE.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

INSTALLATION RESTORATION PROGRAM
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AIR FORCE PLANT NO. 3
Tulsa, Oklahoma

Prepared For

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HQ AFESC/DEV
Tyndall AFB, Florida
and
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Wright Patterson AFB, Ohio

December 1983

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Initial Assessment/Records Search; Phase II, Confirmation and Quantification; Phase III, Technology Base Development; and Phase IV, Operation/Remedial Actions. Engineering-Science (ES) was retained by the United States Air Force to conduct the Phase I, Initial Assessment/Records Search for Air Force Plant No. 3 under Contract No. F08637-83-R0043.

INSTALLATION DESCRIPTION

Air Force Plant No. 3 is located in Tulsa County, Oklahoma, within the City of Tulsa. The plant site is adjacent to the Tulsa International Airport and the area surrounding the plant is mostly in commercial and agricultural use. Aircraft that are serviced at the plant fly into and out of the Tulsa International Airport. The plant site is 332 acres. Almost all of the plant site has been developed and the only significant open area is located on the east side between the parking lot and North Mingo Road.

The plant was constructed by the Federal government in 1940 and began operation in 1941. The facility was used to assemble bombers from 1941 to 1945 and was operated by Douglas Aircraft Company. From 1946 to 1950 the plant was inactive and the site was used for storage of aircraft and other military equipment. The plant was reactivated in 1951 and Douglas Aircraft began operating the plant for assembly, manufacturing and maintenance of aircraft. Rockwell International became a tenant organization in 1962 and has manufactured components for military and space equipment.

ENVIRONMENTAL SETTING

The environmental setting data reviewed for this investigation indicate that the following elements are relevant to the evaluation of past hazardous waste management practices at Air Force Plant No. 3:

- o Net precipitation at the plant is -14 inches which indicates that there is little potential for leachate generation at hazardous waste sites. Rainfall intensity at the plant indicates that there is a good potential for erosion and transport of surface contamination from hazardous waste sites. The one-year, 24-hour rainfall event used to gauge erosion and runoff was 3.2 inches.
- o Most of the precipitation that falls on the plant site runs off the site. The large area of concrete aprons and buildings, together with the low infiltration capability of the near-surface geologic deposits, does not allow much rainfall to infiltrate to the ground.
- o Two minor aquifers exist at the plant site. These aquifers are the Quaternary age terrace deposits and the Nowata Formation. The degree of hydraulic connection between the aquifers cannot be determined from the available information.
- o The permeability of the near-surface deposits at the plant varies between 10^{-5} and 10^{-8} centimeters per second, which does not allow for rapid infiltration or movement of ground water.
- o Surface and ground waters in the vicinity of the plant site are generally not used. The area receives its water supply from the City of Tulsa.
- o A portion of the southeast corner of the plant site is within the 100-year flood plain.
- o No threatened or endangered species inhabit the plant site.

METHODOLOGY

During the course of this project, interviews were conducted with 36 plant personnel (past and present) familiar with past waste disposal practices; file searches were performed for past hazardous waste activities; interviews were held with local, state and Federal agencies; and a field tour was conducted at past hazardous waste activity sites. Six sites were identified as potentially containing hazardous contaminants resulting from past activities (Figure 1). These sites have been assessed using a Hazard Assessment Rating Methodology (HARM) which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration, and waste management practices. The details of the rating procedure are presented in Appendix F and the results of the assessment are given in Appendix G and summarized in Table 1. The rating system is designed to indicate the relative need for follow-on investigation.

FINDINGS AND CONCLUSIONS

The following conclusions have been developed based on the results of the project team's field inspection, review of plant records and files, and interviews with plant personnel. The areas determined to have a sufficient evidence to indicate potential environmental contamination are as follows:

Hazardous Waste Storage Site A
Hazardous Waste Storage Site B
Hazardous Waste Storage Site C

The areas determined to have insufficient evidence to warrant follow-on investigations are as follows:

Hardfill Area
Fire Protection Training Area
Low-Level Radioactive Waste Disposal Area

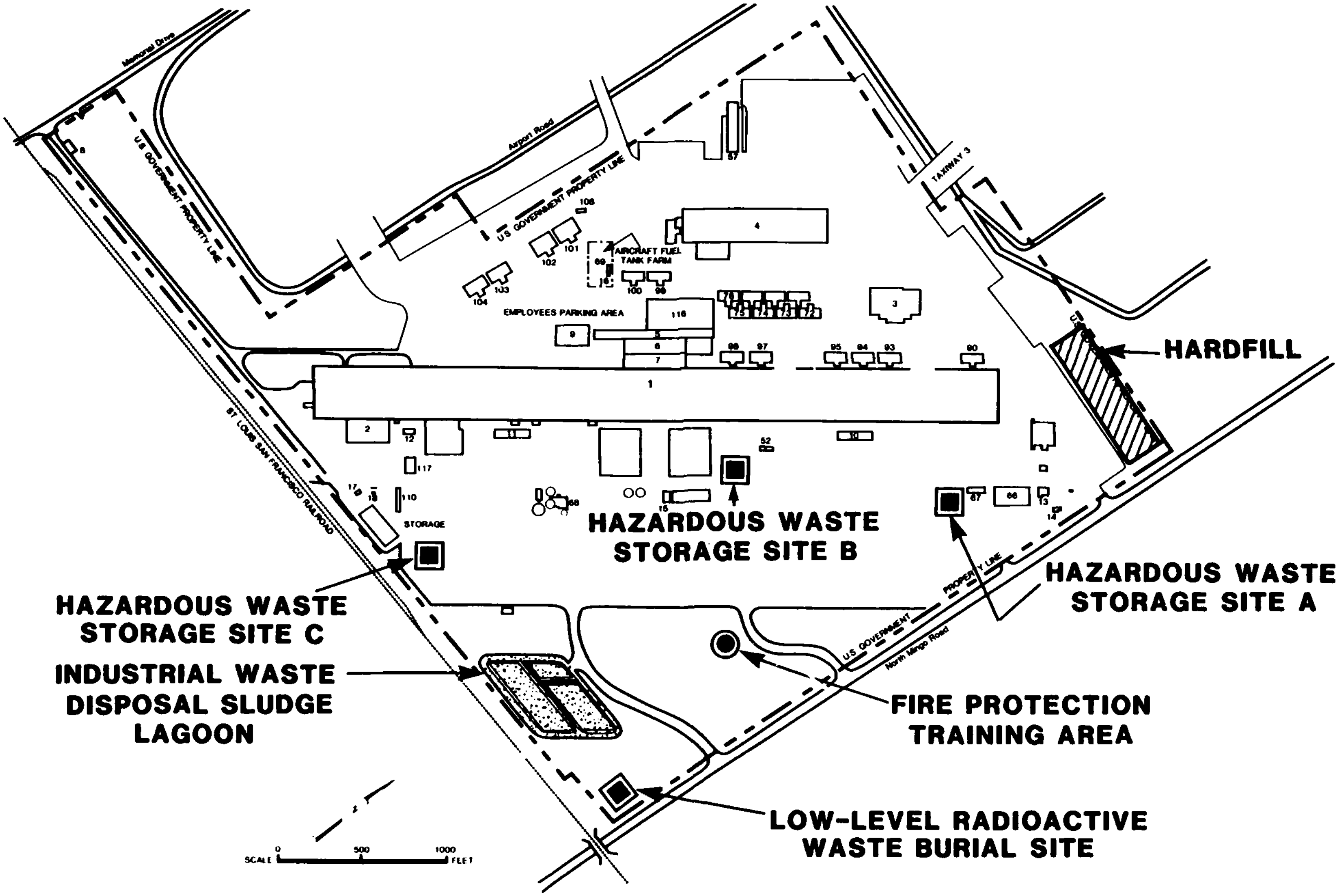
RECOMMENDATIONS

A program for proceeding with Phase II of the IRP at Air Force Plant No. 3 is presented in Chapter 6. The Phase II recommendations are summarized as follows:

FIGURE 1

USAF PLANT NO. 3

SITES OF POTENTIAL ENVIRONMENTAL CONTAMINATION



SOURCE: USAF PLANT NO. 3 INSTALLATION DOCUMENTS

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TABLE 1
SITES EVALUATED USING THE HAZARD ASSESSMENT
RATING METHODOLOGY
AIR FORCE PLANT NO. 3

Rank	Site	Operating Period	Final HARM Score
1	Hazardous Waste Storage Area A	1964-Present	50
2	Hazardous Waste Storage Area B	1976-Present	50
3	Hazardous Waste Storage Area C	1962-Present	50
4	Hardfill Area	1942-1946 and 1952-1959	46
5	Fire Protection Training Area	1951-Present	45
6	Low-Level Radioactive Waste Diposal Area	1952 - 1969	37

Hazardous Waste Storage Sites A, B, and C	Collect two soil borings at each site and analyze for total organic halogens, oil and grease, and phenols. Also analyze for PCB's at storage site A.

CHAPTER 1

INTRODUCTION

BACKGROUND

The United States Air Force, due to its primary mission of defense of the United States, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that dIsposers identify the locations and contents of past disposal sites and take action to eliminate hazards in an environmentally responsible manner. The primary Federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Section 6003 of the Act, Federal agencies are directed to assist the Environmental Protection Agency (EPA) and under Section 3012, state agencies are required to inventory past disposal sites and make the information available to the requesting agencies. To assure compliance with these hazardous waste regulations, the Department of Defense (DOD) developed the Installation Restoration Program (IRP). The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation Restoration Program. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous contamination, and to control hazards to health and welfare that resulted from these past operations. The IRP will be the basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and clarified by Executive Order 12316. CERCLA is the primary federal legislation governing remedial action at past hazardous waste disposal sites.

PURPOSE AND SCOPE OF THE ASSESSMENT

The Installation Restoration Program has been developed as a four-phased program as follows:

Phase I	- Initial Assessment/Records Search
Phase II	- Confirmation and Quantification
Phase III	- Technology Plant Development
Phase IV	- Operations/Remedial Actions

Engineering-Science (ES) was retained by the United States Air Force to conduct the Phase I Records Search at Air Force Plant No. 3 under Contract No. F08637-83-R0043. This report contains a summary and an evaluation of the information collected during Phase I of the IRP and recommendations for follow-on actions.

The goal of the first phase of the program was to identify the potential for environmental contamination from past waste disposal practices at Air Force Plant No. 3, and to assess the potential for contaminant migration. The activities that were performed in the Phase I study included the following:

- Review of site records
- Interview of personnel familiar with past generation and disposal activities
- Survey of types and quantities of waste generated
- Determination of estimated quantities and locations of current and past hazardous waste treatment, storage, and disposal
- Definition of the environmental setting at the plant
- Review of past disposal practices and methods
- Field tour of plant facilities
- Collection of pertinent information from Federal, state, and local agencies
- Assessment of potential for contaminant migration
- Development of follow-on recommendations.

ES performed the on-site portion of the records search during September 1983. The following team of professionals were involved:

- E. J. Schroeder, Environmental Engineer and Project Manager, MSCE, 16 years of professional experience
- R. S. McLeod, Hydrologist, 20 years of professional experience
- E. H. Snider, Chemical Engineer, 7 years of professional experience

More detailed information on these three individuals is presented in Appendix A.

METHODOLOGY

The methodology utilized in the Air Force Plant No. 3 Records Search began with a review of past and present industrial operations conducted at the plant. Information was obtained from available records and files, as well as interviews with past and present plant employees from the various operating areas. Those interviewed included 36 current and past personnel associated with McDonnell Douglas Corporation, Rockwell International, and the Defense Contract Administration Services Plant Representatives Office (DCASPRO). A listing of the plant interviewee positions with approximate years of service is presented in Appendix B.

Concurrent with the plant interviews, the applicable Federal, state, and local agencies were contacted for pertinent plant-related environmental data. The agencies contacted and interviewed are listed below and additional information is included in Appendix B.

- U.S. Environmental Protection Agency (EPA), Region VI
- U.S. Geological Survey (USGS), Water Resources Division
- Oklahoma State Department of Health
- Oklahoma Water Resources Board
- U.S. Army Corps of Engineers
- Tulsa City-County Health Department

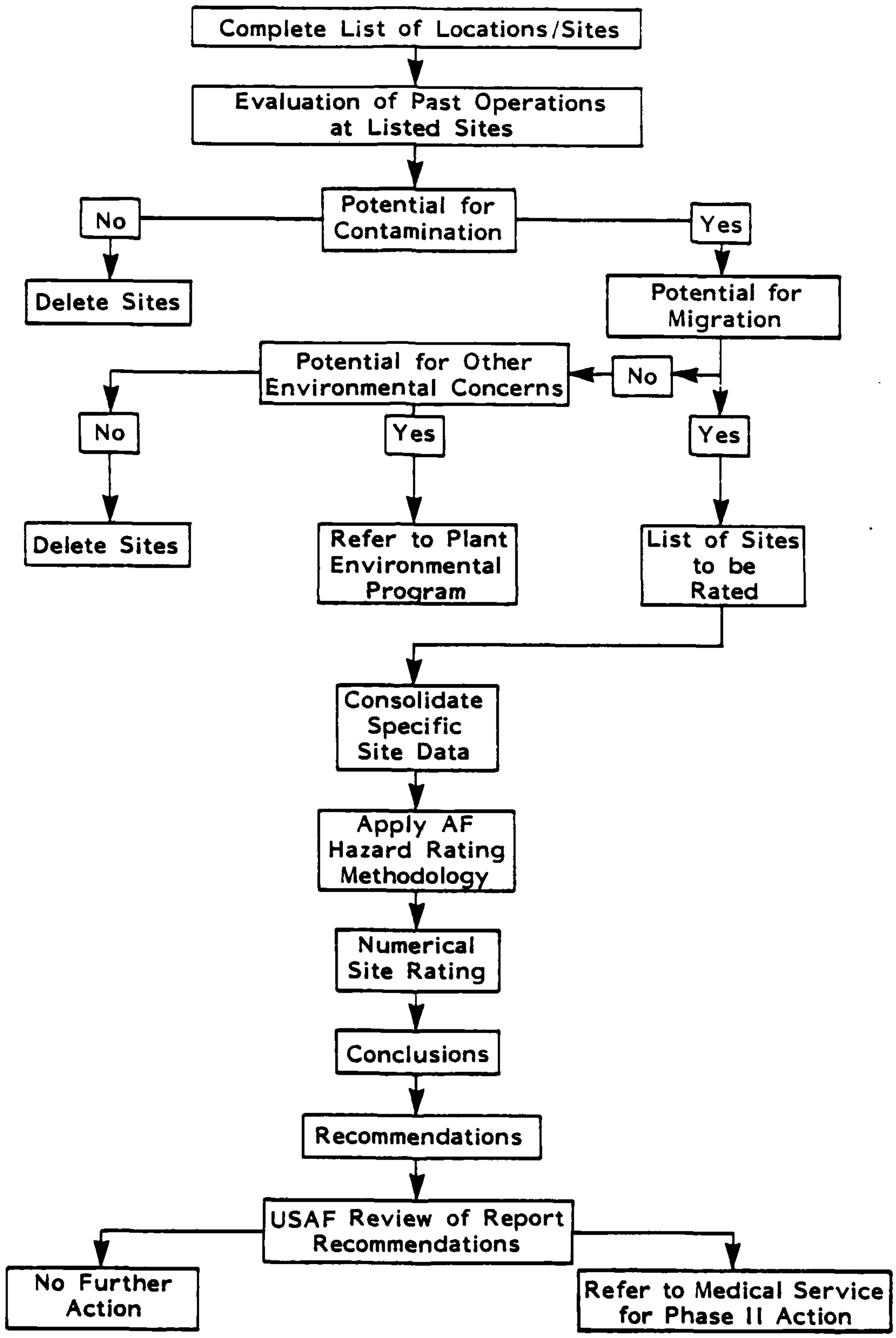
The next step in the activity review was to identify all sources of hazardous waste generation and to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various sources at the plant. A master list of industrial shops is presented in Appendix D. Included in this part of the Activities review was the identification of all known past disposal sites and other possible sources of contamination such as spill areas.

A general ground tour of the identified sites was then made by the ES Project Team to gather site-specific information including: (1) general characteristics of waste management practices; (2) visual evidence of environmental stress; (3) the presence of nearby drainage ditches or surface water bodies; and (4) visual inspection of these water bodies for any obvious signs of contamination or leachate migration.

A decision was then made, based on all of the above information, whether a potential existed for hazardous material contamination at any of the identified sites using the Decision Tree shown in Figure 1.1. If no potential existed, the site was deleted from further consideration. For those sites where a potential for contamination was identified, a determination of the potential for migration of the contamination was made by considering site-specific conditions. If there were no further environmental concerns, then the site was deleted. If there are other environmental concerns then these are refered to the plant environmental program. If the potential for contaminant migration was considered significant, then the site was evaluated and prioritized using the Hazard Assessment Rating Methodology (HARM). A discussion of the HARM system is presented in Appendix F.

PHASE I INSTALLATION RESTORATION PROGRAM

DECISION TREE



CHAPTER 2

INSTALLATION DESCRIPTION

LOCATION, SIZE AND BOUNDARIES

Air Force Plant No. 3 is located in Tulsa County, Oklahoma, within the City of Tulsa (Figures 2.1 and 2.2). The plant site is adjacent to the Tulsa International Airport and the area surrounding the plant is mostly in commercial and agricultural use. Aircraft that are serviced at the plant fly into and out of the Tulsa International Airport. The plant is connected to the airport runways by three taxiways. The plant site is 332 acres and the facility site plan is shown in Figure 2.3. Almost all of the the plant site has been developed and the only significant open area is located on the east side between the parking lot and North Mingo Road.

HISTORY

In 1940, the City of Tulsa approved a bond issue acquiring agricultural land adjacent to the municipal airport. This land was to be the site of a "blackout building" and an aircraft plant; Douglas Aircraft Company began operations in the Tulsa Plant in March of 1941. During World War II, the Douglas Plant was actively involved in the manufacture, assembly, and modification of many of the U.S. Army Air Corps bombers, including the A-24 Dive Bombers and the A-26 Invaders. The plant was used primarily as an assembly plant for bombers.

In 1945, production in the plant was suspended. The plant was then used until 1950 by the Tinker Air Force Base in Oklahoma City as a storage depot for military vehicles, aircraft, and spare parts.

In 1950, the plant was reactivated to manufacture B-47 Stratojets. In 1952, the plant began modification of B-47B's. Then in the spring of 1953, a 10,000 foot North-South runway was constructed at the Airport. In the fall of that same year, a contract was signed for the manufacture of the twin-jet Douglas Bomber, the B-66.

FIGURE 2.1

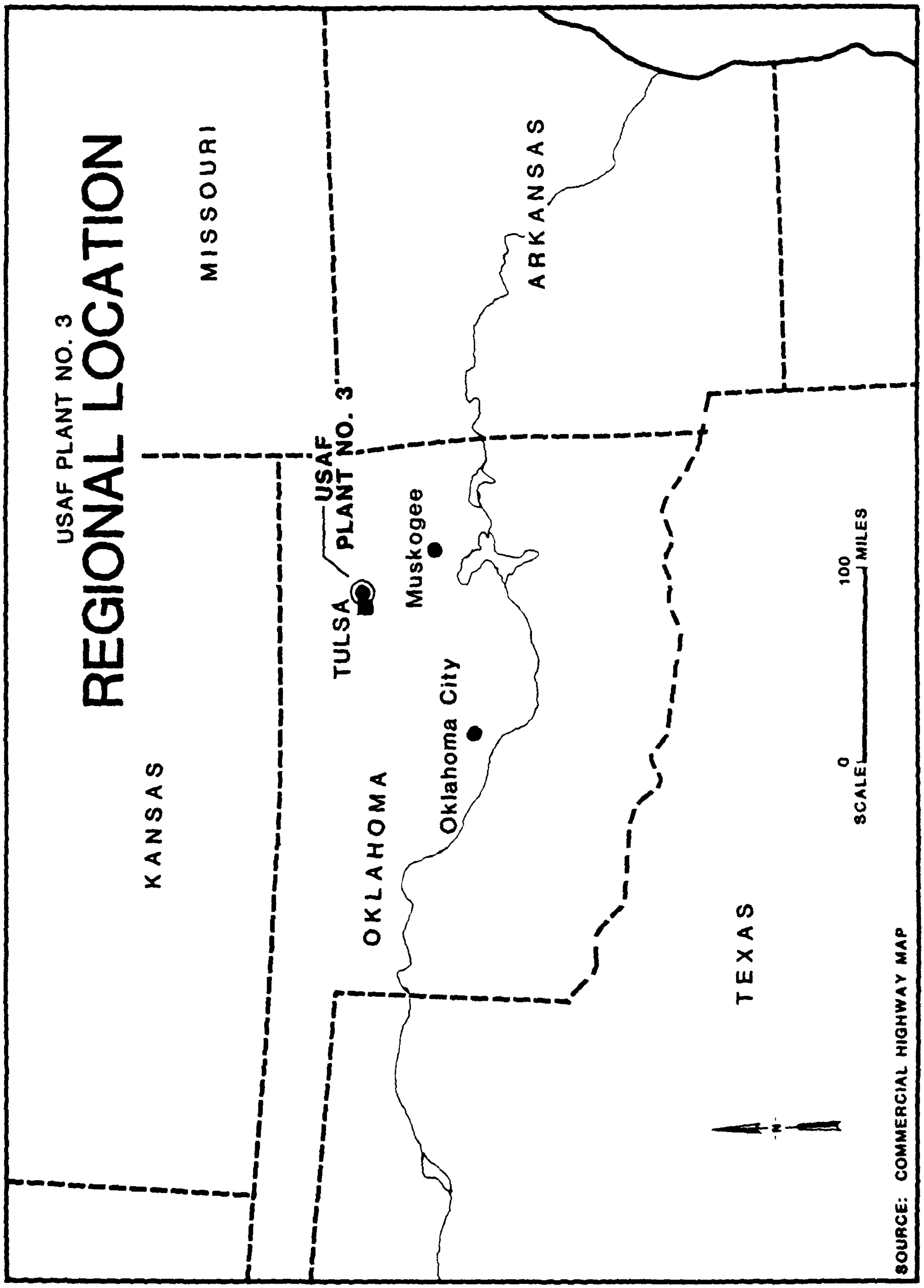


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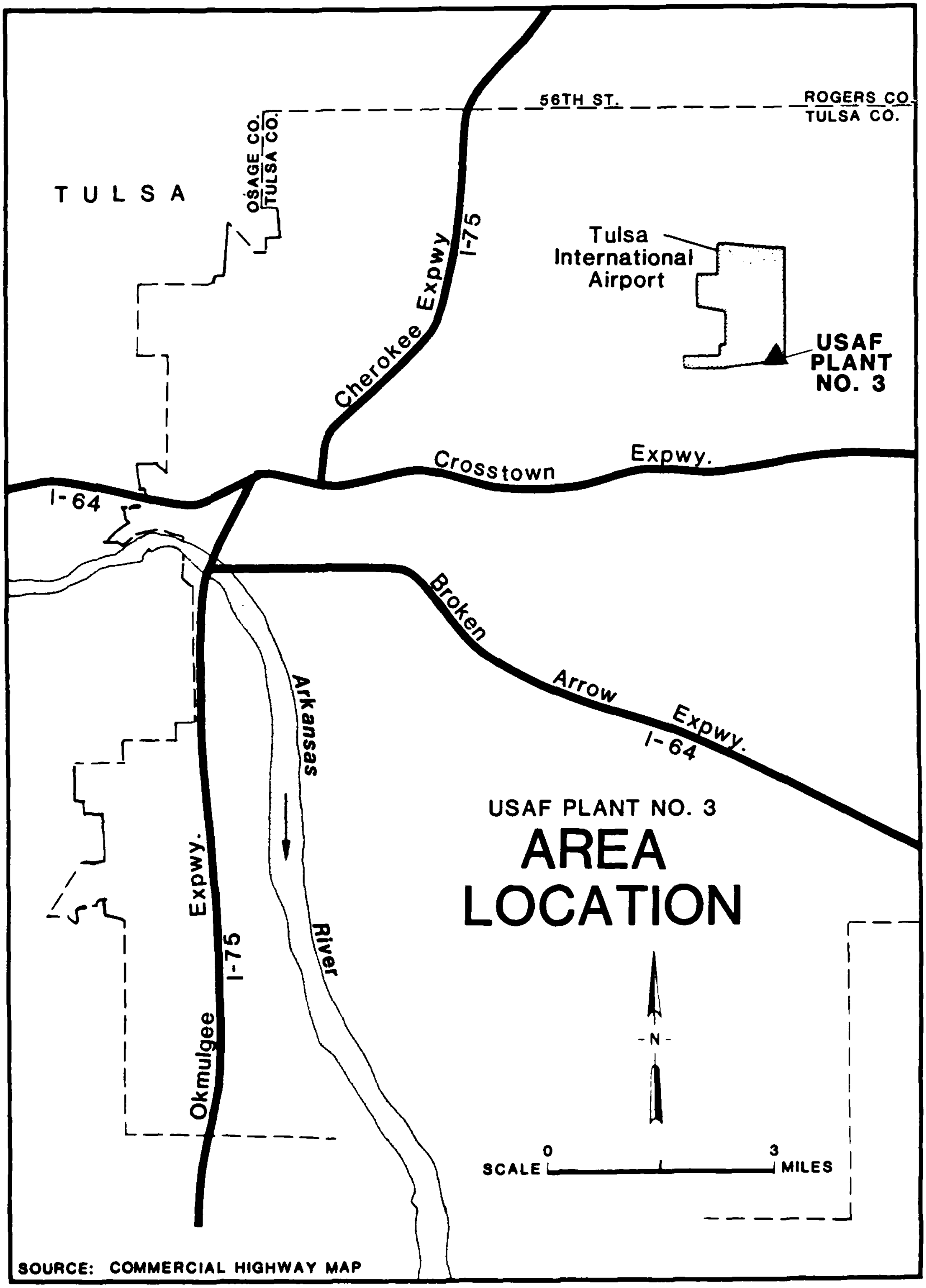
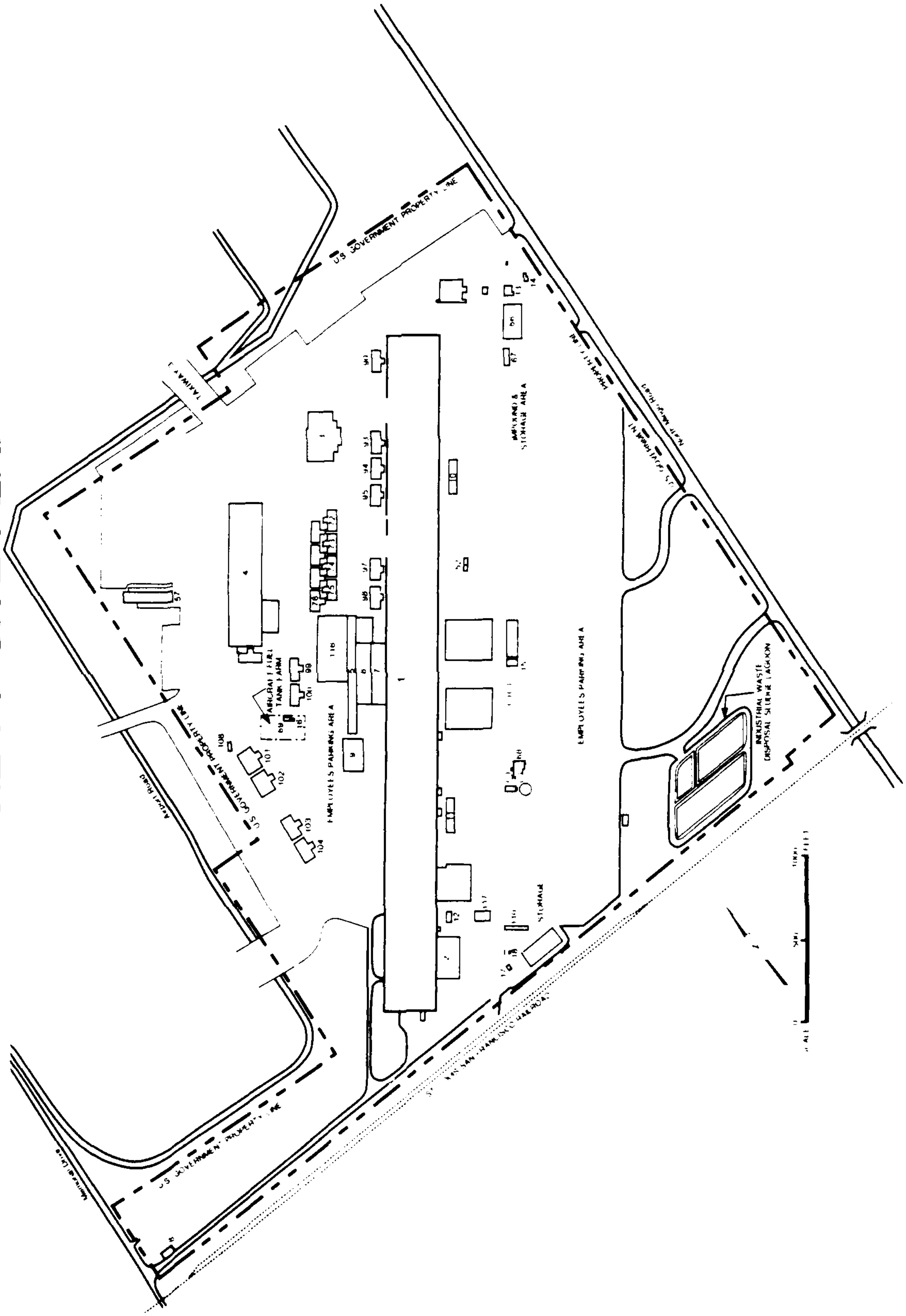
FIGURE 2.2



USAF PLANT NO. 3
AREA LOCATION

FIGURE 2.3

USAF PLANT NO. 3
FACILITY SITE PLAN



SOURCE: USAF PLANT NO. 3 INSTALLATION DOCUMENTS

Beginning in the early 1960's McDonnell Douglas used the Tulsa Plant for performing maintenance on both government and private industry aircraft. In 1962, Rockwell International moved into part of the building space that previously had been occupied solely by McDonnell Douglas. Rockwell International is an independent production operation, with research and engineering facilities. The Tulsa Division of Rockwell International is responsible for such activities as the design, development, and fabrication of the Payload Bay Doors for the Space Shuttle, the manufacturing of the Sabreliner business jet aircraft, and the construction of the Aegis phased array shipborne antennas. Rockwell manufactures aerospace and related products for both government and private industry at Air Force Plant No. 3.

Organization and Mission

The host organization at Air Force Plant No. 3 is McDonnell Douglas. The primary mission of McDonnell Douglas at Air Force Plant No. 3 is to perform depot maintenance on military aircraft and commercial aircraft. Rockwell International is a tenant organization at Air Force Plant No. 3 and uses the facilities for research, engineering and production of components for aircraft and navigational equipment.

CHAPTER 3

ENVIRONMENTAL SETTING

The environmental setting at Air Force Plant No. 3 is described in this section. An understanding of the geology and hydrology is needed to aid in identifying the hydrologic conditions which could contribute to migration of contaminants which may have been introduced into the environment at the plant site and potential receptors that might be impacted as a result of contaminant migration.

METEOROLOGY

Two climatic features of interest in determining the potential for movement of contaminants are net precipitation and rainfall intensity. Net precipitation is an indicator for the potential of leachate generation and is equal to the difference between annual precipitation and annual evaporation. Rainfall intensity is an indicator for the potential of excessive runoff and erosion. The one-year, 24-hour rainfall is used to gauge the potential for runoff and erosion.

Net precipitation indicates that there is a very low probability for leachate generation at hazardous waste sites on the plant site as a result of rainfall. Net precipitation is -14 inches which is considered low. Normal annual precipitation at Tulsa International Airport for the period 1881 to 1981 was 38.03 inches (NOAA, 1981). Annual evaporation for the area is 52 inches (NOAA, 1977). Selected meteorological data are summarized in Table 3.1.

There is a good potential for erosion and transport of surface contamination from hazardous waste sites. The one-year, 24-hour rainfall at the plant site is approximately 3.2 inches (NOAA, [illegible]) which is considered to be high.

TOPOGRAPHY

The Tulsa, Oklahoma area is located in the Osage Plains of the Central Lowland physiographic province. The landscape of the region

TABLE 3.1

SUMMARY OF SELECTED METEOROLOGICAL DATA

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°F)													
Mean(1)	36.7	41.4	50.2	60.9	68.7	77.8	82.7	81.8	74.2	62.9	49.7	40.2	61.5
Precipitation (inches)													
Mean(2)	1.64	1.62	2.86	4.10	5.26	4.71	3.16	3.20	3.80	3.39	2.45	1.84	38.03
Snowfall (inches)													
Maximum Monthly(3)	12.7	10.1	11.8	1.7	0.0	0.0	0.0	0.0	0.0	T(4)	5.6	9.9	12.7

(1) Based on the period 1906-1981
(2) Based on the period 1888-1981
(3) Based on the period 1939-1981
(4) Trace

Source: NOAA (1981)

consists of a gently rolling surface interrupted by low east-facing ridges and isolated buttes capped by sandstone.

The plant is located at Tulsa International Airport on the northeast side of Tulsa. The area south of the airport is highly urbanized while the area east, west and north are sparsely populated.

The airport is in the Verdigris River drainage basin which is a tributary to the Arkansas River. The Verdigris River originates in southeastern Kansas. The river flows generally south and empties into the Arkansas River approximately 55 miles southeast of the airport.

Topography and Drainage

The topography at Air Force Plant No. 3 slopes gently to the east. The highest area on the plant grounds is about 640 feet mean sea level (MSL). This area occurs along the west property line. The lowest area is approximately 600 feet MSL and occurs at the southeast end of the property.

Surface drainage from the plant site discharges to unnamed tributaries of Mingo Creek. Mingo Creek is a tributary to Bird Creek which is a tributary to the Verdigris River (Figure 3.1).

Five storm drainage networks are used to drain surface runoff from the plant site (Figure 3.2). Storm drainage from the northwest side of the plant site is routed to outfall 001 located at the north fence line approximately 1,500 feet west of Mingo Road. Storm drainage from the southwest side of the plant site is routed to outfall 004 located directly south of the main plant building and on the south property boundary. Storm drainage from the southeast side of the plant site is routed to outfall 003 located on the south property boundary approximately 800 feet east of outfall 004. Storm drainage from the northeast side of the plant is routed to two outfalls. One unnumbered outfall is located on the east property boundary at Mingo Road, approximately 1,000 feet south of the north property line. This outfall receives only stormwater runoff. The second outfall, 002, is located on the east property boundary at Mingo Road approximately 2,200 feet south of the north property line.

The drainage networks above outfalls 001 through 004 are used for discharging cooling water, boiler blowdown, and treated wastewater from the plant site as well as for conveying storm drainage. Once through

FIGURE 3.1

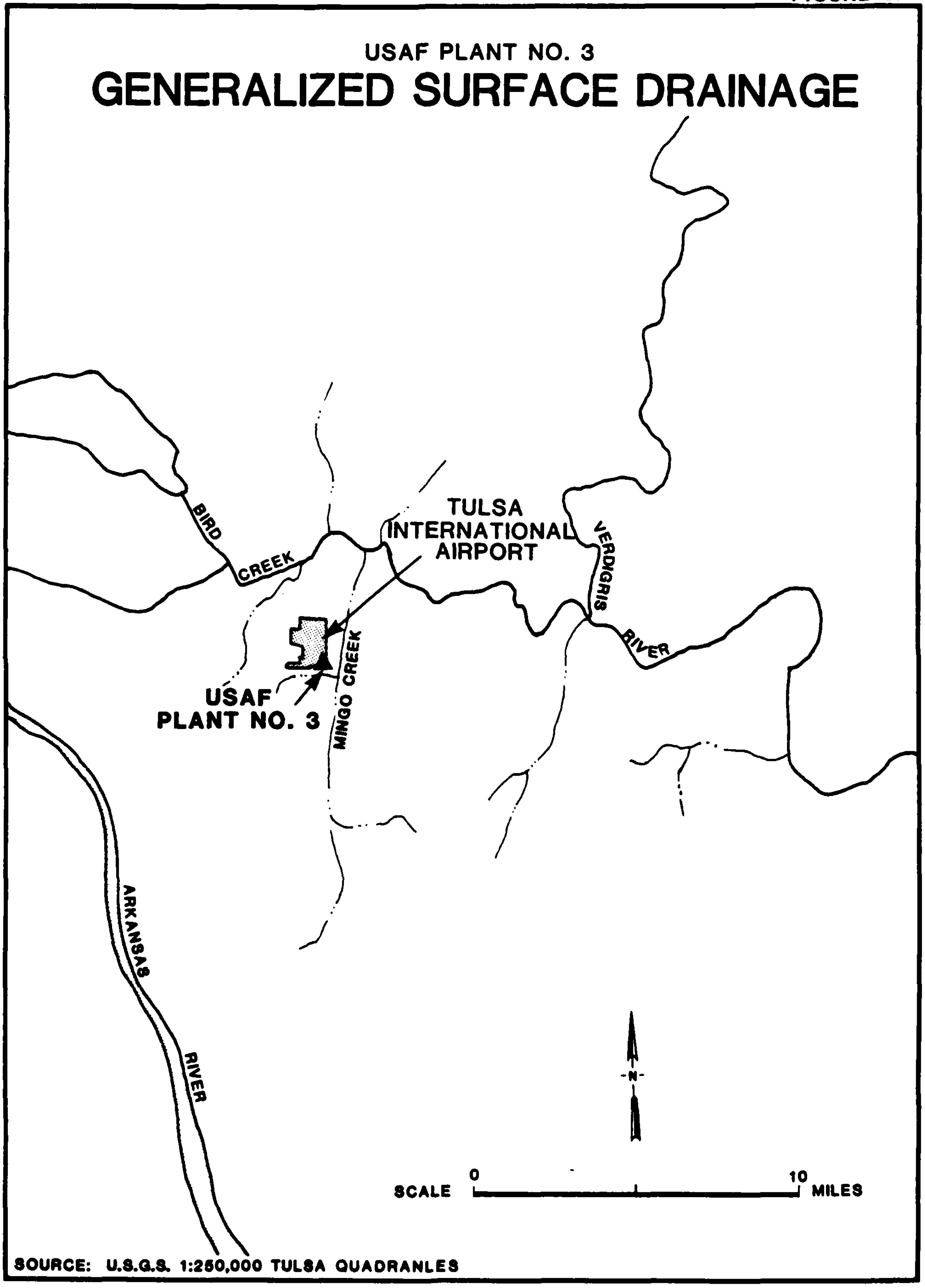
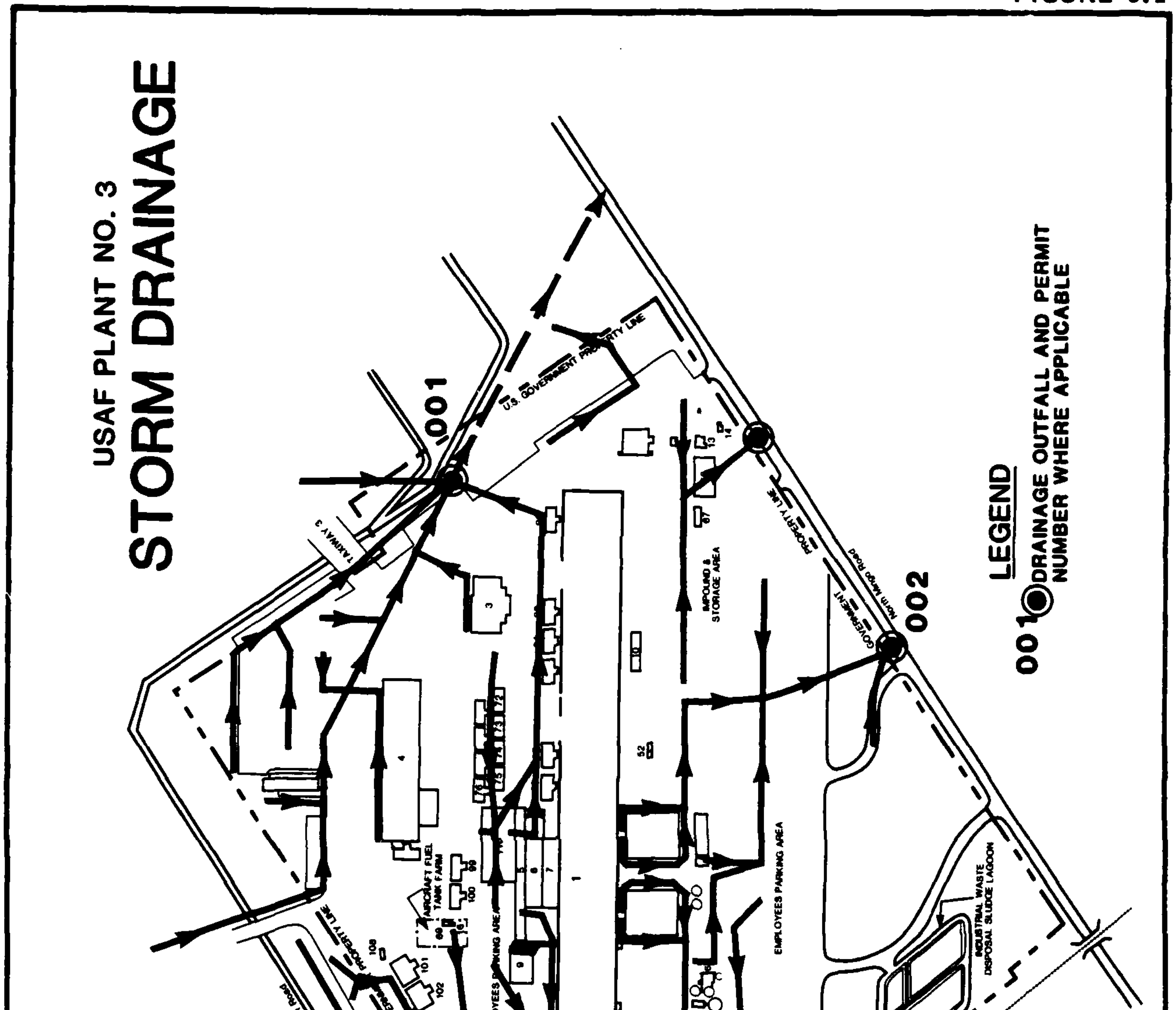

USAF PLANT NO. 3
GENERALIZED SURFACE DRAINAGE
BIRD
CREEK
TULSA
INTERNATIONAL
AIRPORT
VERDIGRIS
RIVER
MINGO CREEK
USAF
PLANT NO. 3
ARKANSAS
RIVER
N
SCALE
0
10
MILES
SOURCE: U.S.G.S. 1:250,000 TULSA QUADRANLES

FIGURE 3.2


USAF PLANT NO. 3
STORM DRAINAGE
001
002
003
004
LEGEND
001 DRAINAGE OUTFALL AND PERMIT NUMBER WHERE APPLICABLE
SOURCE: McDONNELL DOUGLAS DOCUMENTS

cooling water from air compressors in the boiler room is discharged into the storm drainage network above outfall 001. Blowdown water from the main cooling tower is discharged into the storm drainage network above outfall 002. Water from the industrial waste treatment plant is discharged into the storm drainage network above outfall 003. Once through cooling water and water from water-cooled machinary in the south end of the main plant building is discharged into the storm drainage network above outfall 004. The outfalls are regulated by permits from the U.S. Environmental Protection Agency (EPA) and Oklahoma Water Resources Board (OWRB).

GEOLOGY

Stratigraphy

Air Force Plant No. 3 is underlain by rocks of Precambrian age and younger and unconsolidated alluvium and terrace deposits of Quaternary age. Dense crystalline rock of Precambrian age forms the basement upon which younger geologic units were deposited. The depth below land surface to these rocks is approximately 3,100 feet as determined from a drilling log for an injection well located about 2,500 feet north of the north boundary of the plant site.

A layered sequence of sedimentary rocks of Cambrian to Pennsylvanian age overlies the Precambrian rocks. These rocks include sandstone, dolomite, shale and limestone. Pennsylvanian rocks form the bedrock surface in the Tulsa area. These rocks are mostly shale and limestone and have a total thickness that exceeds 1,100 feet at the plant site. A stratigraphic column representing the sequence of rocks in the area is given in Table 3.2.

The surficial deposits at Air Force Plant No. 3 include unconsolidated terrace deposits of Quaternary age and residual soils derived from the Nowata Formation. The terrace deposits occur as a north-south trending band that is about 2,000 feet wide. The Nowata Formation underlies the terrace deposits and is the surficial unit on the plant site wherever the terrace deposits are absent. The areal distribution of surficial deposits is shown on Figure 3.3.

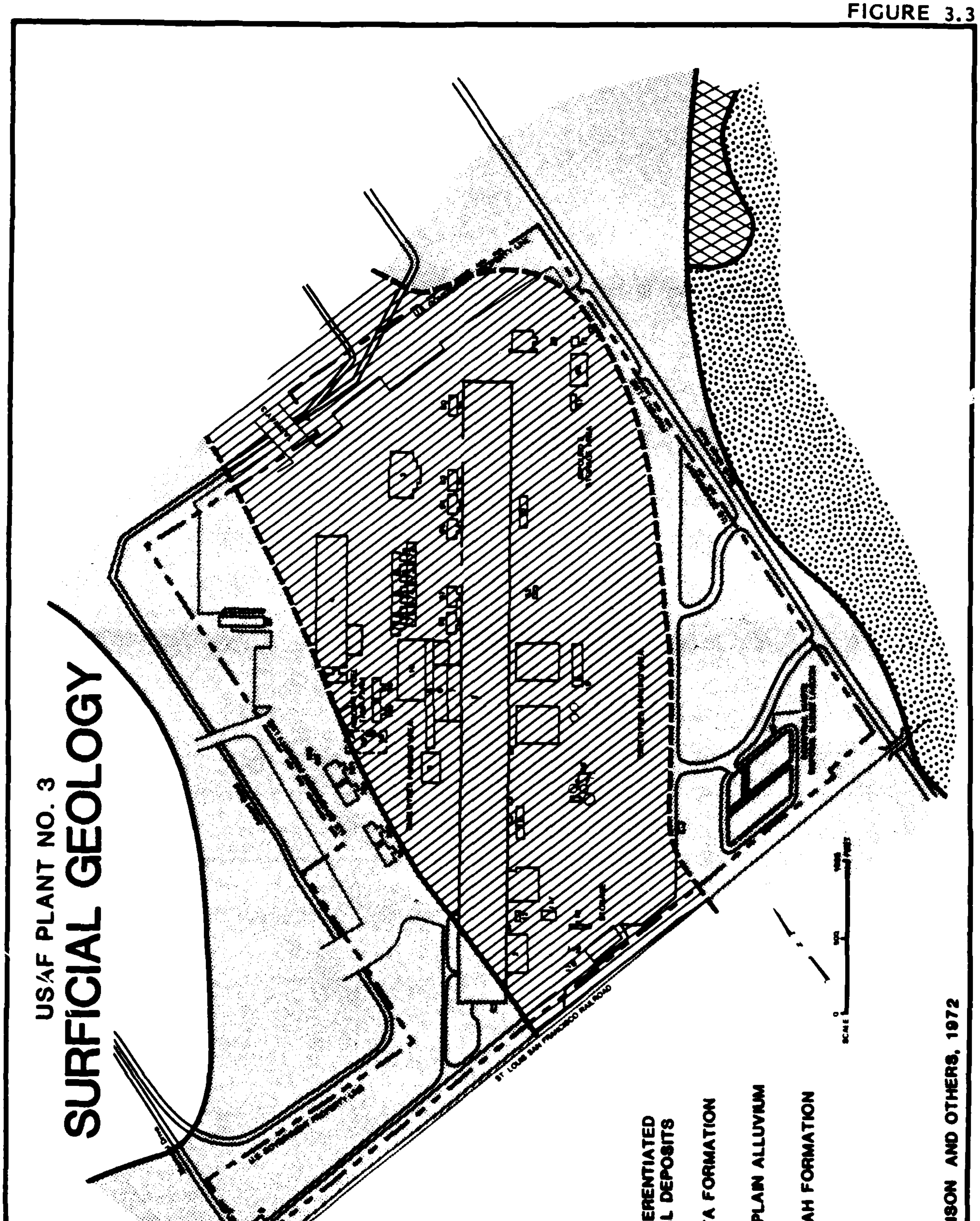
The unconsolidated deposits are generally silty clay, sandy clay, and clay. These deposits vary in thickness from about 10 to 25 feet

TABLE 3.2

GENERALIZED STRATIGRAPHY

System	Group or Formation	Thickness (Feet)	Dominant Lithology
Quaternary	Terrace deposits	15-25	Clay
	Nowata Formation	150	Shale
	Oologah Formation	90	Limestone
Pennsylvanian	Labette Formation	200	Shale
	Fort Scott Limestone	40	Limestone
	Senora Formation	260	Shale
	Boggy Formation	400+	Shale
	Lower Pennsylvanian rocks and older		

FIGURE 3.3


USAF PLANT NO. 3
SURFICIAL GEOLOGY
LEGEND
UNDIFFERENTIATED GLACIAL DEPOSITS
NOWATA FORMATION
FLOODPLAIN ALLUVIUM
OOLOGAH FORMATION
ST LOUIS SAN FRANCISCO RAILROAD
SOURCE: RENNISON AND OTHERS, 1972

(Table 3.3). The terrace deposits are composed mostly of silty and sandy clay and have a maximum thickness of about 25 feet. The residual soil overlying the Nowata Formation is mostly silty clay and clay. The general thickness of the terrace deposits, as derived from soil borings prior to constructing the main plant building, is shown on Figure 3.4.

Structure

The rocks underlying the Tulsa area slope gently to the west. This slope results from uplift of the Ozark Plateau which has brought progressively older formations to the surface east of the Tulsa area. The western edge of the Ozark Plateau lies approximately 30 miles east of Tulsa and extends from northeastern Oklahoma across southern Missouri and northern Arkansas.

HYDROLOGY

Subsurface Hydrology

Unconsolidated alluvial and terrace deposits along river courses are the major sources for ground water in the Tulsa area (Gould, 1972). The alluvium along the Arkansas River is the major aquifer in the area. Unconsolidated deposits along Bird Creek and its tributaries, including Mingo Creek, contain limited aquifers. Jenks, Oklahoma, south of Tulsa, uses water from the unconsolidated Arkansas River alluvial deposits as its source of supply.

The Pennsylvanian rocks in the Tulsa area are poor aquifers. Wells completed in these rocks generally yield only a fraction of a gallon to a few gallons per minute (Marcher and Bingham, 1971).

The Quaternary age terrace deposits and the Pennsylvanian age rocks may be considered as two minor aquifers at the plant site. This conclusion is based on the data collected by Wilson Laboratories (1983) at four observation wells located in the vicinity of the sludge lagoons (Figure 3.5). Observation well MW-1 was completed at the contact between the terrace deposits and residuim derived from the Nowata Formation. This well yielded water with a relatively low mineral content. Observation wells MW-2, MW-3 and MW-4 were completed in the Nowata Formation or its residual soil and yielded a highly mineralized water. Also, the terrace deposits are relatively permeable in comparison to the Nowata Formation and its residual soil. Well MW-1 has a

TABLE 3.3

SUMMARY OF SELECTED SOIL BORINGS

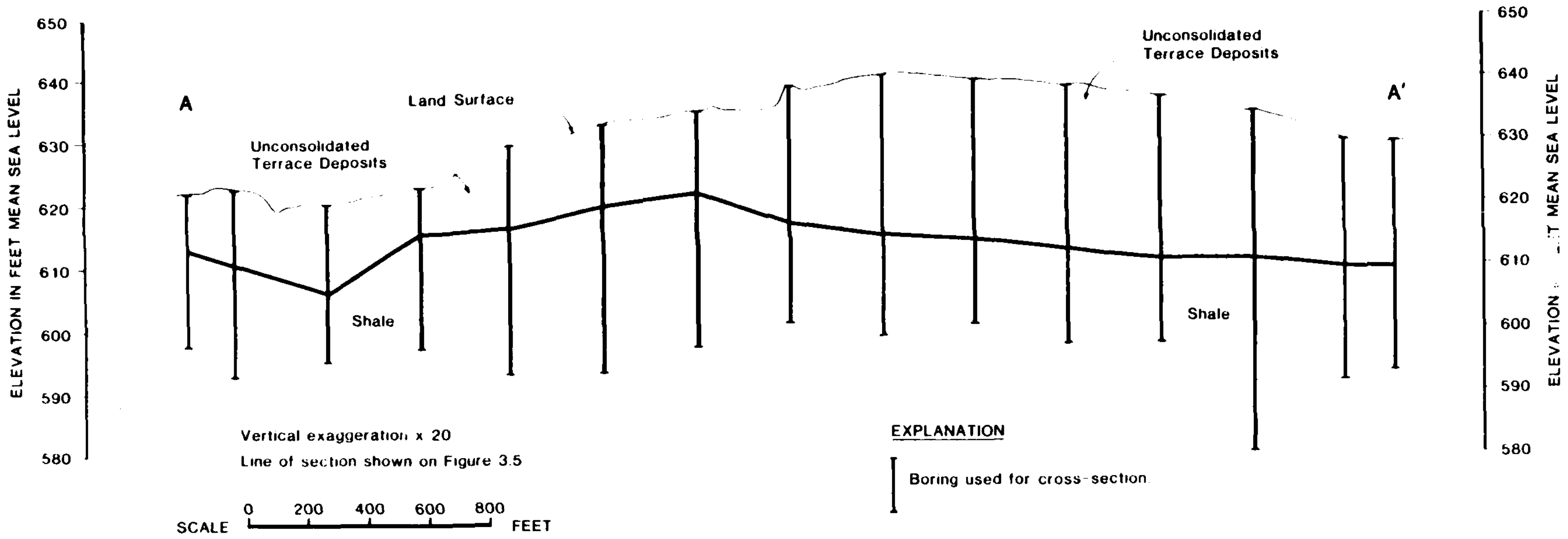
Boring Number	Boring Depth (Feet)	Lithology
MW-1	0-1.0	Clay, silty
	1.0-12.0	Clay, tan
	12.0-20.0	Shale
MW-2	0-1.5	Clay, silty
	1.5-7.0	Clay, tan with lire fragments (fill)
	7.0-10.0	Clay, brown to tan (fill)
	10.0-16.0	Clay, silty
	16.0-19.0	Clay, tan
	19.0-25.0	Shale
MW-3	0-4.0	Clay, tan to brown with rock fragments (fill)
	4.0-6.8	Clay, tan
	6.8-13.0	Clay, silty
	13.0-19.0	Clay, shaley
	19.0-25.0	Shale
MW-4	0-3.5	Clay, brown to tan
	3.5-5.0	Clay, tan
	5.0-15.0	Shale
24	0-2.0	Silt, sandy
	2.0-9.0	Clay, sandy
	9.0-33.5	Shale
6	0-2.5	Silt, sandy
	2.5-6.0	Clay, silty
	6.0-20.0	Clay, sandy
	20.0-24.5	Clay, silty
	24.5-42.5	Shale

Borings MW-1 to MW-4 from Wilson Laboratories (1983)
Borings 6 and 24 from Air Force documents
Boring locations shown on Figure 3.5

FIGURE 3.4

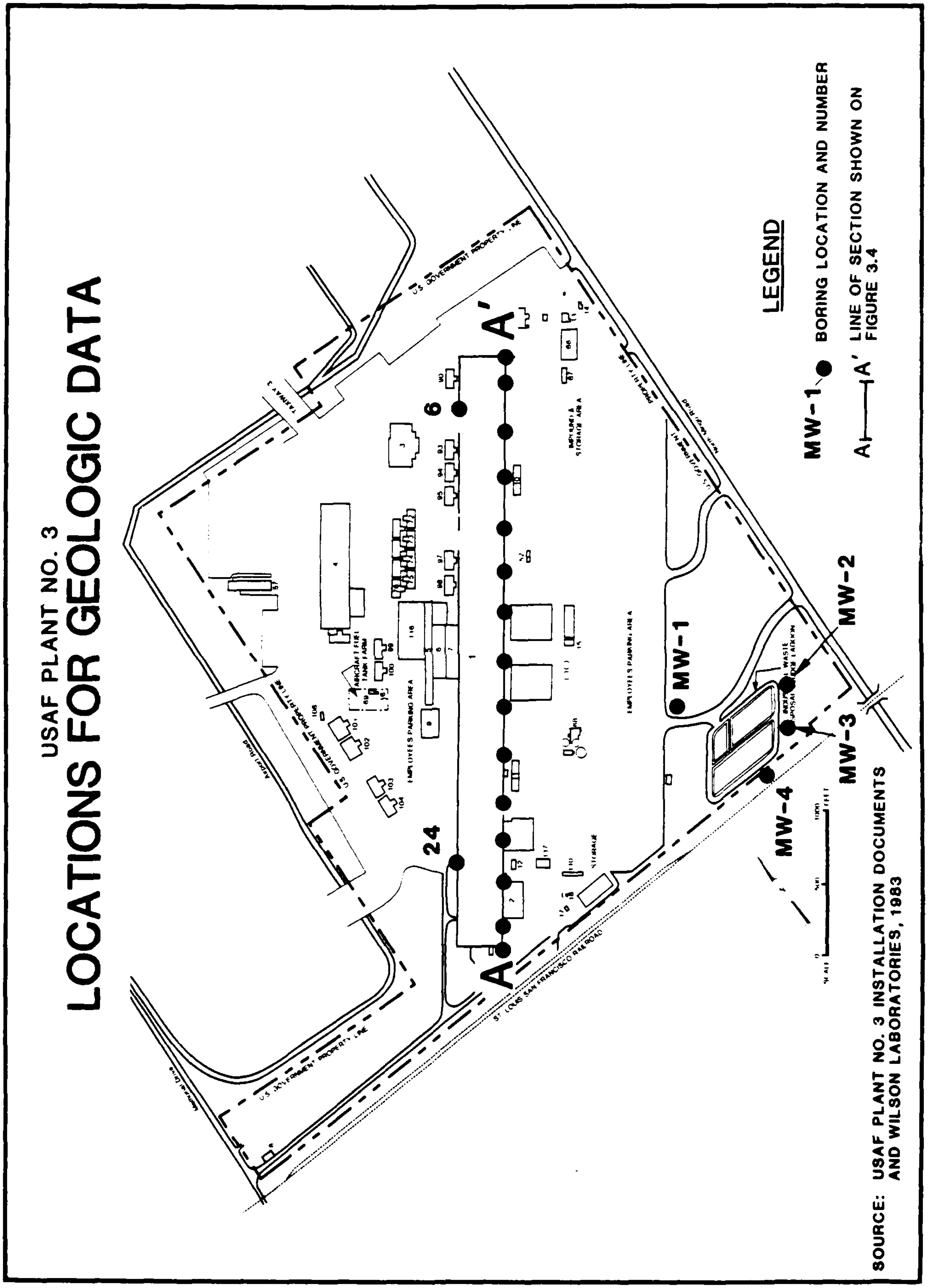
USAF PLANT NO. 3

GEOLOGIC CROSS-SECTION THROUGH TERRACE DEPOSITS



SOURCE: U.S. AIR FORCE DOCUMENTS

FIGURE 3.5



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yield of ? to 5 gallons per minute whereas wells MW-2, MW-3 and MW-4 do not completely recharge their casing volume in a 24-hour period. The degree of hydraulic connection between the aquifers cannot be determined from the available information.

Ground-water elevations and ground-water flow directions at the plant site are not well defined. Water levels in shallow borings completed in the Nowata Formation generally stood at elevations of 605 to 620 feet mean sea level in 1942. These borings were drilled as a part of the engineering investigations conducted prior to constructing the plant. Reported water levels in wells MW-1 and MW-4 in the vicinity of the sludge lagoons are 628.0 and 610.5 feet mean sea level, respectively (Wilson Laboratories, 1983).

Shallow ground-water flow at the plant site is probably to the east and southeast. This assumption is based on the fact that the topography in the vicinity of the plant site slopes to the southeast and the postulation that the water table is a subdued replica of topography. Also, Mingo Creek east of the plant site is probably a discharge area for shallow ground water.

The hydraulic conductivity, or permeability, of the near-surface deposits at the plant site is low. Wilson Laboratories (1983) estimated that the permeability of these deposits in the vicinity of the sludge lagoons varied between 10^{-5} and 10^{-8} centimeters per second.

Shallow ground-water flow velocities at the plant site are probably on the order of .001 to 1.0 feet per year. This estimate is based on the permeability of shallow deposits at the sludge lagoons together with the assumptions that the water-table gradient is approximately equal to the average slope of the topography and the effective porosity for the shallow subsurface materials is five percent (Walton, 1965).

Surface Hydrology

Air Force Plant No. 3 is in the Mingo Creek drainage basin. The plant site is drained by storm drainage structures that discharge to unnamed tributaries to Mingo Creek.

Periodic flooding can be expected at the southeast end of the plant site. These floodwaters are in the Mingo Creek flood plain and originate mostly as runoff from the urbanized area south and west of the airport. The approximate limits of flooding for the 100-year flood event are shown on Figure 3.6.

Most of the precipitation that falls on the plant site probably runs off the site. Much of the plant site is a combination of buildings and concrete aprons from which precipitation is drained. Also, the near-surface deposits at the plant site generally have a low hydraulic conductivity which does not allow for rapid infiltration of water.

WATER USE

The plant receives its water supply from the City of Tulsa. Surface and ground waters at the plant are not used for supply.

Surface waters are the main source of water supply for Tulsa, Oklahoma and the surrounding area. These waters come from reservoirs that are located about 55 miles east of Tulsa.

Ground water generally is not used for water supply in the vicinity of the plant. The rural as well as the urbanized area around Tulsa International Airport is serviced by the City of Tulsa Water and Sewer Department.

The water in Mingo Creek has limited use. Mingo Creek is classified as a primary warm water fishery and some fishing may take place in the stream. Also, farm livestock in rural areas may use the stream as a source for drinking water.

WATER QUALITY

Surface water quality has been monitored at each of the storm drainage outfalls that are permitted (see Figure 3.2). The monitored constituents vary at each outfall due to the nature of the effluent being discharged to the storm drainage networks above the outfalls.

The quality of water discharged from the plant site at outfalls 001, 002 and 004 is in general compliance with water-quality requirements established under permits by the EPA and OWRB (Table 3.4). Permit requirements for discharges from these outfalls are identical for both agencies. Sampling by OWRB personnel in March 1983 found the water quality at outfalls 001 and 004 to be within federal and state permit limitations. At outfall 002, total suspended solids in the water

TABLE 3.4

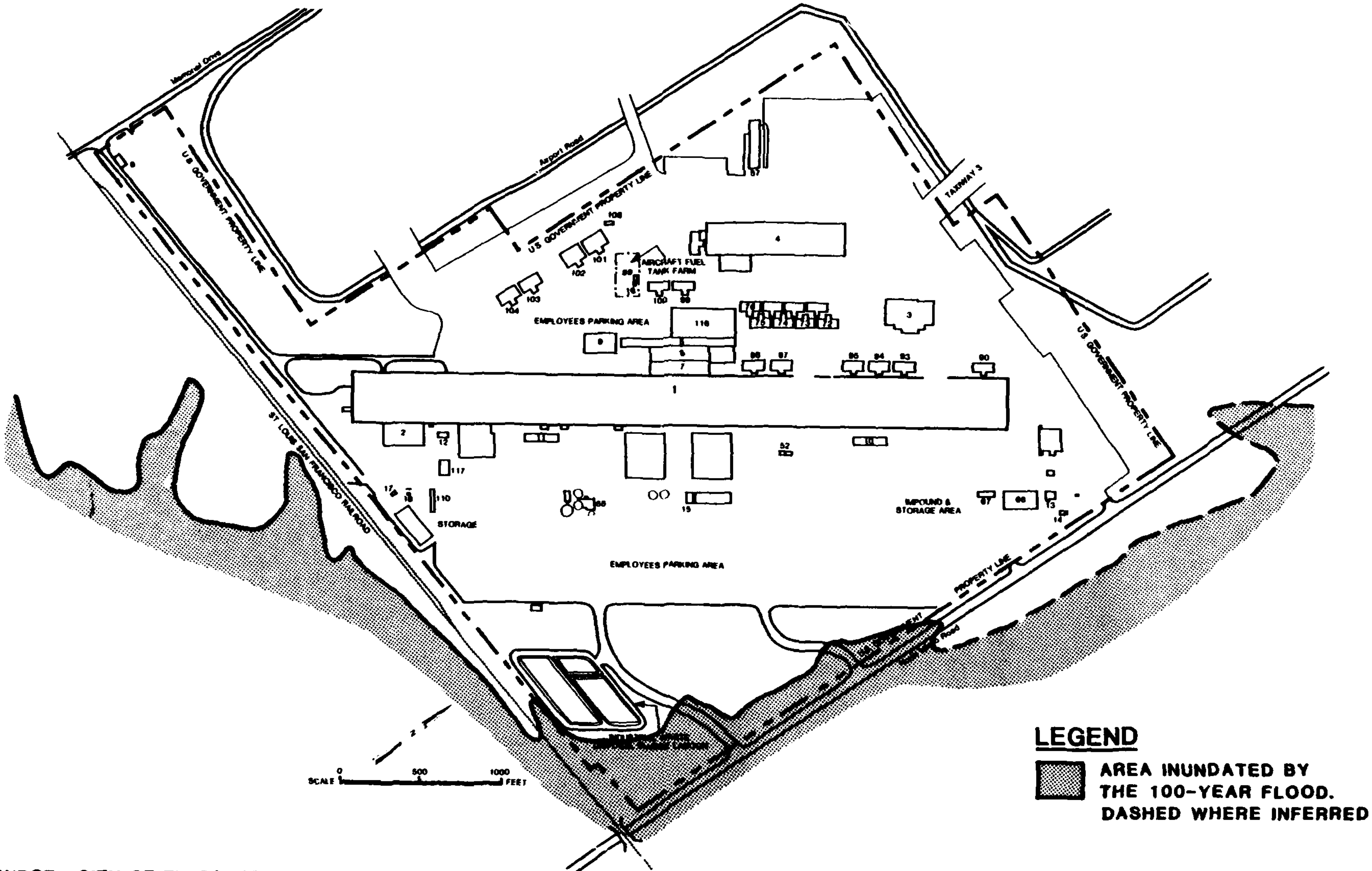
SUMMARY OF SURFACE WATER CHEMICAL ANALYSES

Site ID	Date	Type Sample	pH (Std.Units)	Oil and Grease (mg/l)	Total Suspended Solids (lbs/day)	Cadium (lbs/day)	Copper (lbs/day)	Zinc (lbs/day)	Chromium (lbs/day)	Phosphorus (lbs/day)	Hexavalent Chromium (lbs/day)	Cyanide (lbs/day)	Flouride (lbs/day)	Iron (lbs/day)	Tin (lbs/day)
001	3/23/83	Grab	8.0[1] (6.0-9.0)	1.0 (15M)											
002	3/24/83	Composite	7.1 (6.0-9.0)	2.8 (15M)	19.5 (17M-11A)										
003	3/30/83	Composite	7.2		15.1 (127.6M-75.4A)	<.002 (.09M)	.021 (.28M)	.005 (2.74M-1.89A)	.49 (2.84M-1.89A)	<.002 (2.84M)	<.04 (.38M-.19A)	<.002 (.07M)	13.6 (56.8M-28.4A)	- (7.54M-3.77A)	(7.54M 3.77A)
004	3/24/83	Composite	7.5 (6.0-9.0)	<1.0 (15M)	0.17 (129M-86A)										

1. NPDES permit limits are given in parenthesis. An M represents the permissible maximum discharge for the parameter being measured. An A represents the permissible average daily discharge for the parameter.

USAF PLANT NO. 3

AREA INUNDATED BY THE 100-YEAR FLOOD



LEGEND

AREA INUNDATED BY THE 100-YEAR FLOOD. DASHED WHERE INFERRED

SOURCE: CITY OF TULSA, 1982

exceeded federal and state permit limits while the other water quality parameters were within permit limitations.

The quality of water discharged from the plant site at outfall 003 is generally good, although the EPA and OWRB permit requirements are sometimes exceeded. Both permits are identical except that the OWRB permit limitation for fluoride at outfall 003 is more stringent. The flouride limitation of the OWRB permit is routinely exceeded and permit limits for other parameters have occasionally been exceeded. Sampling by OWRB personnel in March 1983 found the water quality to be within EPA permit limits for all parameters and within OWRB permit limits for all parameters except flouride. The OWRB permit limit for fluoride is 10 milligrams per liter (mg/l) the fluoride concentration in the water was 16.9 mg/l during the March sampling.

Water from the Nowata Formation and overlying residual soil at the plant site is high in dissolved minerals as indicated by the high specific conductance for water from wells MW-2, 3 and 4 (Table 3.5). Wells MW-2 and MW-3 are completed in the residual soil overlying the Nowata Formation. Well MW-4 is completed in the Nowata. Most of the mineralization is probably due to the high sulfate concentration in the water. Sulfate concentration in the water greatly exceeds recommended limits for drinking water. Iron in the water generally exceeds the recommended limits.

Water from the unconsolidated glacial deposits at the plant site is much lower in dissolved minerals than water from the Nowata Formation (Table 3.5). Well MW-1, which is completed mostly in the unconsolidated terrace deposits, has an average specific conductance which is about one-fifth of that for water from the Nowata Formation. Sulfate concentration in water from well MW-1 is generally within recommended limits for drinking water. Iron concentration generally exceeds the recommended limits.

Ground-water quality data are available at two locations near the plant site (Figure 3.7). One location, well 20N-13E-12AA, is a rural supply well approximately 2.5 miles north of the plant site. The other one, well 20N-13E-27BD, is located approximately 1.5 miles west of the plant site. Well 20N-13E-12AA is completed in the Nowata Formation. Well 20N-13E-27BD is completed in the Seminole formation. These wells

TABLE 3.5

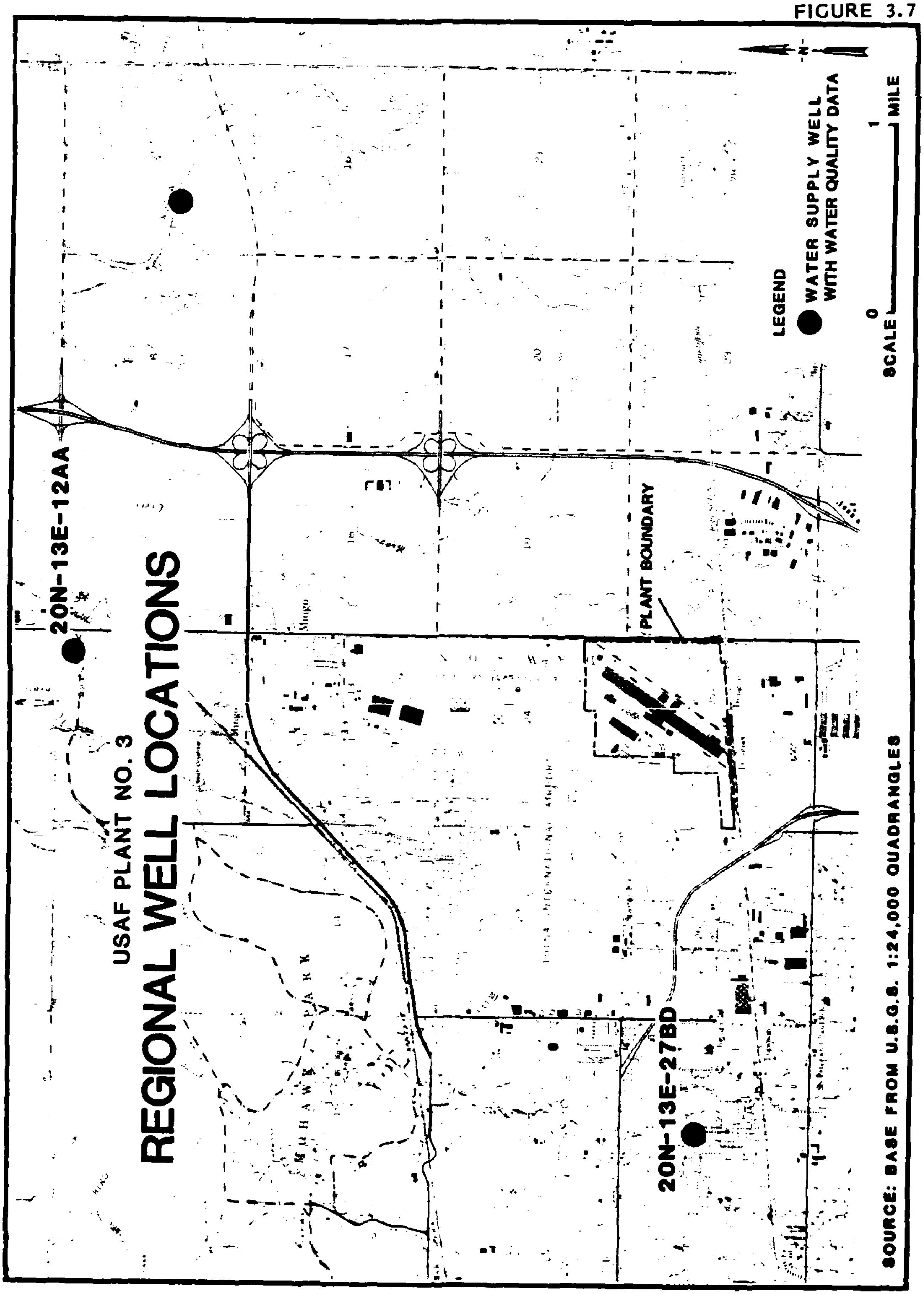
SUMMARY OF GROUND-WATER CHEMICAL ANALYSES
(Analyses in milligrams per liter unless otherwise noted)

Site ID	Date	pH (Std units)	Specific Conductance (Umhos)	Chloride (250)[1]	Iron (0.3)[1]	Manganese	Sodium	Sulfate (250)[1]
MW-1[2]	12/14/81	7.0	658	16.5	46.0	.79	114	187
	3/16/82	7.0	797	22.0	.38	<.02	134	200
	6/22/82	7.1	900	22.0	.20	.05	168	372
	9/15/82	6.9	704	17.4	.18	<.02	95.0	156
	3/4/83	7.5	750	14.0	<.05	<.05	92.0	110
	3/14/83	7.6	715	18.0	.90	.01	90.0	70.
	5/3/83	6.6	635	-	-	-	-	-
MW-2[2]	12/14/81	7.0	4130	102	3.42	5.0	505	3150
	3/16/82	7.0	4200	96.0	.52	6.34	4.82	2600
	6/22/82	6.8	4400	106	.40	5.0	538	3000
	9/15/82	7.2	3700	78.0	.13	9.26	341	2200
	3/4/83	7.2	3250	126	<.05	.81	410	1280
	3/14/83	7.5	3000	91.0	3.5	10.0	350	720
	5/3/83	6.6	3590	-	-	-	-	-
MW-3[2]	12/14/81	8.0	3620	138	341	11.0	822	2020
	3/16/82	6.8	3300	78.0	.26	0.6	440	1760
	6/22/82	7.6	3400	101	.43	3.19	568	1910
	9/15/82	7.8	3100	103	.04	<.02	333	1620
	3/4/83	7.7	3360	116	<.05	<.05	500	1220
	3/14/83	7.6	3000	110	1.1	.66	410	1000
	5/3/83	6.7	3400	-	-	-	-	-
MW-4[2]	12/14/81	7.4	3040	74.5	271	4.85	359	1900
	3/16/82	7.1	3500	88.0	.41	.54	361	2160
	6/22/82	6.9	3800	110	.97	.35	389	2460
	9/15/82	7.4	3900	105	.08	.20	272	2300
	3/4/83	7.0	4190	122	<.05	.14	450	200
	3/14/83	7.5	3800	110	.45	.21	360	1600
	5/3/83	6.7	4380	-	-	-	-	-
20N-13E-12AA[3]	7/10/48	-	1500	312.0	-	-	115.0	23.0
20N-13E-27BD[3]	7/19/48	-	694	46.0	-	-	80.0	90.0

1 Recommended drinking water standard (USEPA, 1975)
2 Wilson Laboratories, 1983
3 USGS, 1978

NOTE: Priority pollutant analyses were performed on samples from wells MW-1, 2, 3 and 4. No materials were identified.

FIGURE 3.7



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were used for water supply in 1948, when they were inventoried by the U.S. Geological Survey, (Havens, 1978). Selected chemical analyses for water from these wells is included in Table 3.5.

Water from the Nowata Formation at the plant site is much higher in dissolved minerals than water from the Nowata north of the plant site. The specific conductance of water from the plant site is approximately twice that from water north of the plant. Specific conductance is an indicator of dissolved minerals in the water. The high sulfate content in water from the plant site probably accounts for the higher dissolved solids in that water.

There is no indication of ground-water contamination from the sludge lagoons located on the southeast corner of the plant site. Ground water sampled from monitoring wells around the lagoons do not contain the contaminants present in the lagoon sludges, (Wilson Laboratories, 1983). The high sulfate content in water from the Nowata at the plant site is attributed to natural conditions (Wilson Laboratories 1983).

BIOTA AND THREATENED OR ENDANGERED SPECIES

Air Force Plant No. 3 has negligible habitat available for wildlife. All of the unpaved land within the fence line is cultivated or mowed. Small mammals and birds common to developed areas utilize the trees and shrubs as temporary shelter. There are no known threatened or endangered plant or animal species on the plant site. The 1983 Tulsa International Airport Master Plan Update indicates that there are no known endangered or threatened plant or animal species on the airport property.

SUMMARY OF ENVIRONMENTAL SETTING

The environmental setting data reviewed for this investigation identified the following major points that are relevant to the Air Force Plant No. 3:

- Net precipitation at the plant is -14 inches which indicates that there is little potential for leachate generation at hazardous waste sites. Rainfall intensity at the plant indicates that there is a good potential for erosion and transport of surface contamination from hazardous waste sites. The one-year, 24-hour rainfall event used to gauge erosion and runoff was 3.2 inches.

- Most of the precipitation that falls on the plant site runs off the site. The large area of concrete aprons and buildings, together with the low infiltration capability of the near-surface geologic deposits, does not allow much rainfall to infiltrate to the ground.
- Two minor aquifers exist at the plant site. These aquifers are the Quaternary age terrace deposits and the Nowata Formation. The degree of hydraulic connection between the aquifers cannot be determined from the available information.
- The permeability of the near-surface deposits at the plant varies between 10^{-5} and 10^{-8} centimeters per second, which does not allow for rapid infiltration or movement of ground water.
- Surface and ground waters in the vicinity of the plant site are generally not used. The area receives its water supply from the City of Tulsa.
- A portion of the southeast corner of the plant site is within the 100-year flood plain.
- No threatened or endangered species inhabit the plant site.

CHAPTER 4

FINDINGS

This chapter summarizes the hazardous wastes that have been generated on the plant site, describes past waste management and disposal methods, identifies the disposal sites located at the plant, and evaluates the potential for environmental contamination from those sites.

PAST SHOP AND PLANT ACTIVITY REVIEW

A review was conducted of current and past waste generation and management methods in order to identify those activities that resulted in the generation of hazardous waste. This activity consisted of a review of files and records, interviews with current and former plant employees, and site inspections.

The sources of hazardous waste at Air Force Plant No. 3 can be associated with one of the following activities:

- Industrial Operations (shops)
- Fire Protection Training
- Fuels Management
- Pesticide Utilization
- Waste Storage
- Spills

The following discussion emphasizes those wastes generated at Air Force Plant No. 3 which are either hazardous or potentially hazardous. In this discussion a hazardous substance is defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and a potentially hazardous waste is one which is suspected of being hazardous, although insufficient data are available to fully characterize the waste material.

Industrial Operations (Shops)

Industrial operations at Air Force Plant No. 3 have been conducted by McDonnell Douglas Corporation and by Rockwell International. From 1942 to 1946 the plant was operated by Douglas Aircraft Company (now McDonnell Douglas Corporation) primarily as an assembly plant for bombers. Some manufacturing and modificaton of aircraft was also performed at the plant. The production facilities were inactive from 1946 to 1950 and the site was used for storage of military equipment. The plant was reactivated in 1951 and has been operated by McDonnell Douglas since that time for assembly and depot maintenance of military and commercial aircraft. Rockwell International became a tenant at the plant in 1962. Rockwell has manufactured components for aircraft, the space program, and military ships and vehicles.

The wastes generated from the present industrial operations were used as a starting point for defining the past waste generation and waste management practices at the plant. There were no shop files maintained to identify waste generation by unit operation. Therefore, the department operations were reviewed with company employees familiar with the operations. From this review a list was developed that contains the department name and number, the location, hazardous material handlers, hazardous waste generators, and typical treatment, storage, and disposal methods. This list appears in Appendix D.

Those shops which were determined to be generators of hazardous waste were selected for further investigation and evaluation. During the site visit, interviews were conducted with personnel specifically familiar with these shop operations and waste generation. These interviews focused on hazardous waste generation, waste quantities, and methods of storage, treatment, and disposal of hazardous waste. Manifest records were also used to define present waste generation and management practices. Historical information was obtained primarily from interviews with various employees. Table 4.1 summarizes the information obtained from the detailed shop reviews including information on shop location, identification of hazardous or potentially hazardous wastes, present waste quantities, and treatment, storage, and disposal timelines. Changes in the treatment, storage and disposal methods are

TABLE 4.1

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME AND DEPARTMENT	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1950 1960 1970 1980
McDONNELL DOUGLAS CORPORATION				
BOILER ROOM, T708	7	DEIONIZATION RESINS	7 DRUMS/YR.	1974 CD
		DEIONIZATION REGENERATION WASTE	25,000 GALS./YR.	NEUTRALIZED TO SANITARY SEWER
		WASTE OIL (HEAVY)	2 DRUMS/YR.	CD
		WASTE OIL (LIGHT)	15 DRUMS/YR.	CONTRACT RECYCLER
MACHINE TOOL OVERHAUL, 703	63	WASTE HYDRAULIC FLUID	10 DRUMS/YR.	1953 CD
		WASTE OIL	5 DRUMS/YR.	CONTRACT RECYCLER
X RAY LABORATORY, 840	1	DEVELOPING AND PRINT WASTE	500 GALS./YR.	SILVER RECOVERY AND SANITARY SEWER 1982
HYDRAULICS, 556	1	WASTE HYDRAULIC FLUID	15 DRUMS/YR.	1953 CD
ALUMINUM HEAT TREATMENT AND PROCESS, T452	62	SOLVENTS SLUDGE	1 DRUM/YR.	1978 CD
		ALKALINE CLEANER	60,000 GALS./YR.	1963 IWTP
		METAL ETCHING SOLUTION	30,000 GALS./YR.	CD
		ACID DESMUT	15,000 GALS./YR.	CD
		CONVERSION COATING WASTE	8,000 GALS./YR.	IWTP

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

CD CONTRACT DISPOSAL, OFF PLANT

IWTP INDUSTRIAL WASTE TREATMENT PLANT

DRUM 55 GALLON VOLUME

TABLE 4.1 (Cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME AND DEPARTMENT	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1950 1960 1970 1980
ALUMINUM HEAT TREATMENT AND PROCESS, T452 (CONT'D)		CHROMIC ACID ANODIZE WASTE	6,000 GALS./YR.	1963 IWTP
		PAINT/SOLVENT MIXTURES	25 DRUMS/YR.	1973 CD
		PAINT BOOTH CLEANING WASTE	15 DRUMS/YR.	CD
ELECTRONICS BUILDING, 559	57	WASTE WIRE ETCHANT	5 GALS./YR.	IWTP
F 18 EXTERNAL STORES, 564	1	WASTE PAINT/SOLVENT MIXTURES	75 DRUMS/YR.	1976 CD
		PAINT BOOTH CLEANING WASTE	10 DRUMS/YR.	CD
		PAINT BOOTH EFFLUENT	3,000 GALS./YR.	IWTP
METAL BOND, 497	2	METAL BOND ETCH	2,500 GALS./YR.	1966 IWTP
		ALKALINE CLEANER	5,000 GALS./YR.	IWTP
PAINT HANGAR, 594	3	PAINT STRIPPING WASTE LIQUID	1,140,000 GALS./YR.	1952 SANITARY SEWER (estimated) 1979 CD
		AIRCRAFT WASH WATER	150,000 GALS./YR.	SANITARY SEWER
		PAINT STRIPPING SLUDGE	3,000 GALS./YR.	WASTE LAGOONS OR CD (estimated) CD
		WASTE PAINT/SOLVENT MIXTURES	75 DRUMS/YR.	CD (estimated)
PHOTOGRAPHY, 265	116	DEVELOPING AND PRINT WASTE	2,860,000 GALS./YR.	SILVER RECOVERY AND SANITARY SEWER
NONDESTRUCTIVE TESTING, 840	1	WASTE PENETRANT	8 DRUMS/YR.	IWTP 1969 CD

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

CD CONTRACT DISPOSAL, OFF PLANT

IWTP INDUSTRIAL WASTE TREATMENT PLANT

DRUM 55 GALLON VOLUME

TABLE 4.1 (Cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME AND DEPARTMENT	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
AUTOMOTIVE MAINTENANCE, 707	63	WASTE OIL	600 GALS./YR.	1951 CONTRACT RECYCLER
AVIATION FUEL, 169	16	FUEL/SOLTROL MIXTURES	24,000 GALS./YR.	CONTRACT RECYCLER OR FIRE PROTECTION TRAINING AREA
		FUEL FILTERS	20 UNITS/YR.	1942 1946 HARDFILL FIRE PROTECTION TRAINING AREA
CHEMICAL MILL, 451	1	LIQUID CHEMICAL MILL WASTE	33,000 GALS./YR.	1973 CD
		CHEMICAL MILL SLUDGE	65 DRUMS/YR.	CD
		SCALE CONDITIONER WASTE	11,000 GALS./YR.	CD
		SCALE CONDITIONER SLUDGE	4 DRUMS/YR.	CD
		PAINT WASTE	5 DRUMS/YR.	CD
		PAINT BOOTH CLEANING WASTE	5 DRUMS/YR.	CD
		PAINT BOOTH EFFLUENT	1,000 GALS./YR.	IWTP
		TITANIUM PICKLE	10,000 GALS./YR.	CD
		ALKALINE CLEANER	60,000 GALS./YR.	IWTP
DC 8 MODIFICATIONS, 599	1	WASTE SOLVENTS	20 DRUMS/YR.	CD 1978

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

CD CONTRACT DISPOSAL, OFF PLANT

IWTP INDUSTRIAL WASTE TREATMENT PLANT

DRUM 55 GALLON VOLUME

TABLE 4.1 (Cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME AND DEPARTMENT	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 – 1960 – 1970 – 1980)
ELECTRICAL MAINTENANCE, 702	63	PCB CONTAMINATED MATERIAL (GLOVES, TOWELS, OIL DRY)	12 LBS./YR.	1952 - - - PLANT TRASH OFF SITE DISPOSAL - - - 1979; PCB STORAGE AREA —→
MAINTENANCE PAINT BOOTH	63	PAINT AND SOLVENT MIX	20 DRUMS/YR.	- - - - CD ——→
ROCKWELL INTERNATIONAL				
PUBLICATIONS AND PHOTO LABS, 917	1	DEVELOPING AND PRINT WASTES	100 GALS./YR.	1952 SANITARY SEWER ——→
SHIPPING AND TRANSPORTATION, 951	1	WASTE OIL, TRANSMISSION FLUID AND HYDRAULIC FLUID	5 DRUMS/YR.	CONTRACT RECYCLER - - - 1970
MACHINE SHOP, 961	1	WASTE OIL	1,780 GALS./YR.	CONTRACT RECYCLER - - -
		COOLANT	1,780 GALS./YR.	CD - - -
DETAIL FABRICATION, 962	1	WASTE OIL	445 GALS./YR.	CONTRACT RECYCLER - - -
		COOLANT	445 GALS./YR.	CD - - -
BONDING AND PLASTICS, 965	1	WASTE SOLVENT	500 GALS./YR.	CD ——→
PAINT AND PROCESSING, 966	1	DEGREASER SLUDGE	100 GALS./YR.	CD ——→
		ALKALINE CLEANER	6,400 GALS./YR.	IWTP ——→

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

CD CONTRACT DISPOSAL, OFF PLANT

IWTP INDUSTRIAL WASTE TREATMENT PLANT

DRUM 55 GALLON VOLUME DRUM

TABLE 4.1 (Cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME AND DEPARTMENT	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 1960 1970 1980)
PAINTING AND PROCESSING, 966 (CONT'D)		SPOT WELD ETCH WASTE	1,700 GALS. (SINGLE EPISODE)	IWTP 1965
		ACID ETCH SOLUTION	5,200 GALS./YR.	1962 IWTP →
		CHROMIC ACID ANODIZE WASTE	6,200 GALS./YR.	IWTP →
		SULFURIC ACID ANODIZE WASTE	1,000 GALS./YR.	IWTP →
		ALUMINUM CHEMICAL MILL SOLUTION	19,000 GALS./YR.	IWTP → CD →
		CADMIUM PLATING LIQUID WASTE	2,000 GALS. (SINGLE EPISODE)	IWTP 1966
		CADMIUM PLATING SLUDGE	800 GALS. (SINGLE EPISODE)	SLUDGE LAGOONS
		INCONEL CHEMICAL MILL (ACID)	90 GALS./YR.	1930 IWTP →
		ALUMINUM SALT HEAT TREAT	23,200 LBS./YR.	1969 IWTP →
		NITRIC ACID PAINT STRIPPING	1,500 GALS./YR.	1958 IWTP → 1983 CD →
		TITANIUM CHEMICAL MILL	200 GALS./YR.	1969 IWTP → CD →
		WASTE CONVERSION COATING ACID SOLUTION	9000 GALS./YR.	1962 IWTP → 1981 CD →
		WASTE CONVERSION COATING ACID SOLUTION (WEST WALL BUILDING 1)	50 GALS. (SINGLE EPISODE)	IWTP 1965

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

------ ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

CD CONTRACT DISPOSAL, OFF PLANT

IWTP INDUSTRIAL WASTE TREATMENT PLANT

TABLE 4.1 (Cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME AND DEPARTMENT	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 / 1960 / 1970 / 1980)
PAINTING AND PROCESSING, 966 (CONT'D)	1	SOLVENT	5,550 GALS./YR.	1962 CD →
		PAINT SLUDGE	76 DRUMS/YR.	CD →
		SODIUM ALUMINATE SLUDGE	4 DRUMS/YR.	CD →
		NiCl	1 DRUM (ONE TIME DISPOSAL)	CD 1983
FACILITY ENGINEERING, 982	1	AMMONIA SOLUTION (BLUE LINE)	0.5 GALS./YR.	1962 IWTP →
PLANT SERVICES, 986	TP 103	SPENT SOLVENT	200 GALS./YR.	CD →
	068	WASTE TREATMENT STORAGE TANK SLUDGE	20,000 GALS. (SINGLE EPISODE)	CD 1980
		CLARIFIER SLUDGE	1,300,000 GALS./YR.	1952 SLUDGE LAGOONS →
LABORATORIES, 996	1	WASTE CHEMICALS	100 GALS./YR.	1962 SANITARY SEWER →

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

CD CONTRACT DISPOSAL, OFF PLANT

IWTP INDUSTRIAL WASTE TREATMENT PLANT

DRUM 55 GALLON VOLUME

noted on the table. The McDonnell Douglas Corporation and Rockwell International operations are separated on the table.

Almost all of the hazardous wastes generated at the industrial operations presently go to the industrial waste treatment plant or into drums and are hauled off-site by contractors for disposal or reclamation. There are three hazardous waste collection and storage areas at the plant where waste drums were stored. Several of the industrial wastes that are now disposed of off-site were previously discharged into the industrial waste sludge lagoons and to the sanitary sewer system.

There was little information available concerning the wastes generated at the plant between 1942 and 1946. It is believed that waste generation was small because the nature of the operation was primarily assembly of aircraft. Some wastes may have been disposed of in the area north of Building 1 during the years 1942 to 1946.

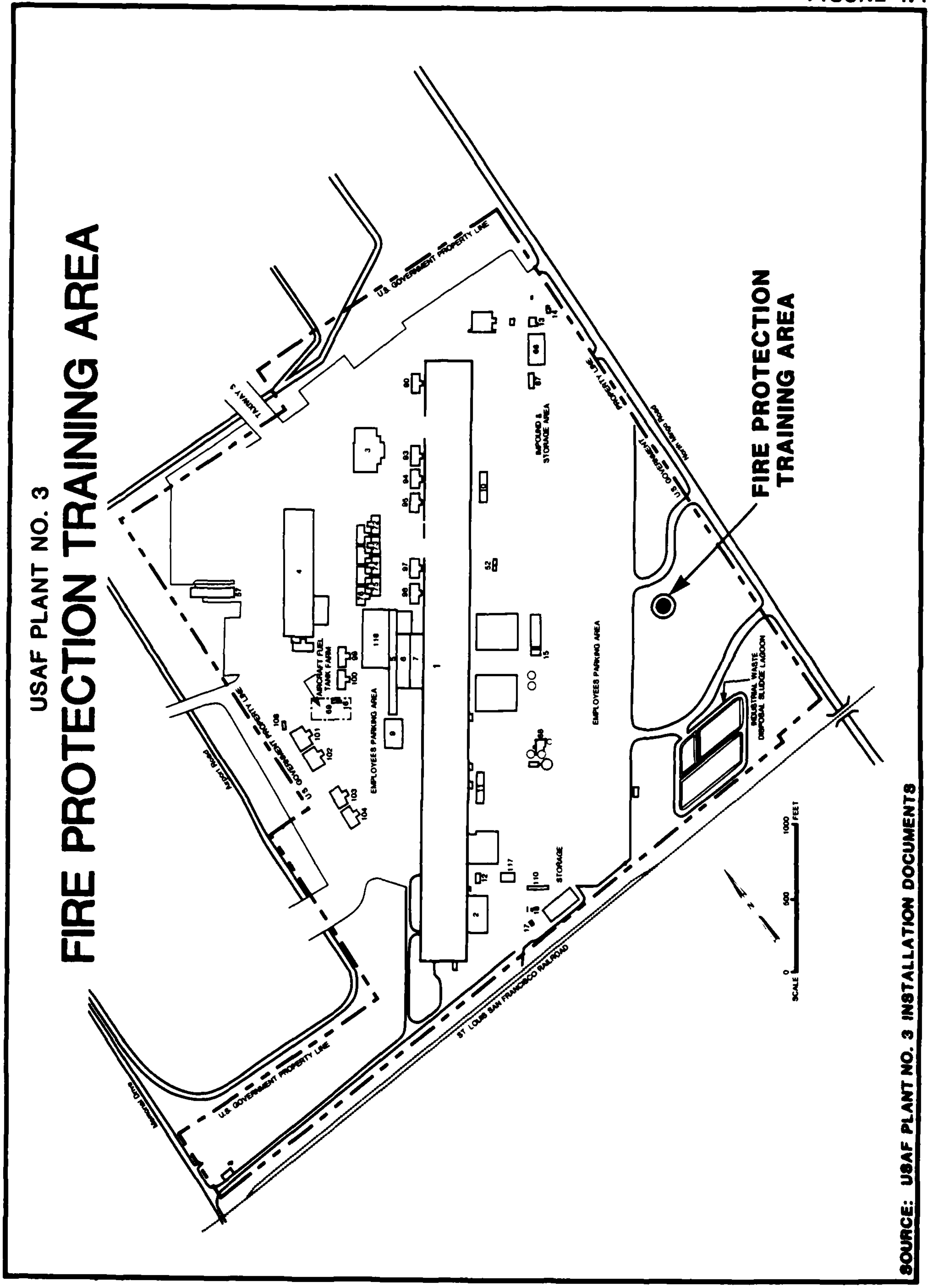
Fire Protection Training

The Security Department of McDonnell Douglas Corporation has conducted the fire training exercises at Air Force Plant No. 3 since 1952. The fire training exercises have been performed at two sites, one on the plant property and the other at the joint use fire training area located north of the plant on airport property. The on-site fire protection training area is located on the east side of the plant between the employee parking lot and North Mingo Road (Figure 4.1). There was no information available to indicate that fire protection training exercises were conducted at any other location on the plant site. There were no fire protection training areas known to exist at the plant during the 1942 to 1946 operating period.

The on-site fire protection training area is a depressed circular area about 50 feet in diameter. This area has been used since about 1951. The Security Department has performed training exercises about once every six months. During the last five years most of the training exercises have been conducted at the airport fire protection training area instead of the on-site area.

The fuels used for the training exercises have primarily been contaminated fuel and Soltrol. The fuel was taken to the site in drums

FIGURE 4.1



ES ENGINEERING-SCIENCE

and about 100 to 200 gallons was used per fire. Fuel filters and tank sludges have also been used as a fuel source. Presoaking of the soil with water prior to burning was practiced occasionally. The fires have been extinguished with water, protein foam, and aqueous film forming foam (AFFF). During the tour of the area there was evidence of contaminated surface water flow moving east from the site.

Fuels Management

The fuels management system at Air Force Plant No. 3 initially consisted of six 25,000 gallon underground tanks located in the fuel tank farm by Building 60. These six tanks were used to store Avgas from 1942 to 1946. The tanks were supplied by tank trucks which unloaded at the concrete apron east of the tank farm. An aqua system was used for unloading the storage tanks. Fuel could be pumped directly into the aircraft next to the tank farm or into trucks that delivered fuel to the aircraft.

The tank farm was taken out of service when the plant was shut down from 1946 to 1951. When the plant resumed operations the six tanks were cleaned; some of the tanks were used for storing JP-4, and the remaining tanks were used to store Avgas. A pump system was constructed in 1954 to replace the aqua system. A pipeline was also added between the tank farm and the railroad line to allow tank car shipment of fuel. Five additional 25,000 gallon underground tanks have been constructed in the tank farm. Seven tanks are used for storing JP-4, two tanks are used for storing Jet-50, and two tanks are used for storing Soltrol. Soltrol is a solution used for cleaning fuel tanks on aircraft that are being defueled prior to overhauling.

The storage tanks have been inspected weekly by two methods: gauging for inventory control and sampling to check for water contamination. Once every three years the tanks have been taken out of service, cleaned, and inspected for leaks. Sludge removed from the cleaning operation is usually less than five gallons. The sludge has been previously disposed of at the hardfill, at the fire protection training area, and most recently by an off-site contractor.

Leaks have been detected as a result of ground-water leakage into four of the storage tanks. A fiberglass lining was installed in each of these tanks and the tanks were returned to service. No fuel leakage from the tanks was observed.

About 1973, pressure tests of the underground transfer line from the railroad to the tank farm indicated a possible leak. The line was taken out of service and has not been used since. The leak was not confirmed or located. There was no evidence of environmental stress identified.

Fuel filters are replaced by Maintenance Department personnel from McDonnell Douglas Corporation. The spent filters have been picked up by the fire protection personnel and taken to the hardfill or the fire protection training area for disposal.

Pesticide Utilization

The pesticide management program at the plant has been the responsibility of the Plant Engineering Department (Maintenance) of McDonnell Douglas Corporation since 1951. Except for herbicide application during the last five years (1978-1983), all pesticide spraying at the plant has been performed by an outside contractor. The contractor did chemical mixing and equipment cleaning at his own facilities located off the plant property.

The Maintenance Department of McDonnell Douglas Corporation has sprayed herbicides four times during the summer for the last five years. The herbicides are mixed in a portable 200 gallon tank. After spraying; the tank is cleaned with water and the rinse water is discharged to the industrial sewer. Containers have been rinsed and then disposed of with general refuse.

There was no information available on the pesticide management program during the time the plant was operated from 1942 to 1946.

Waste Storage

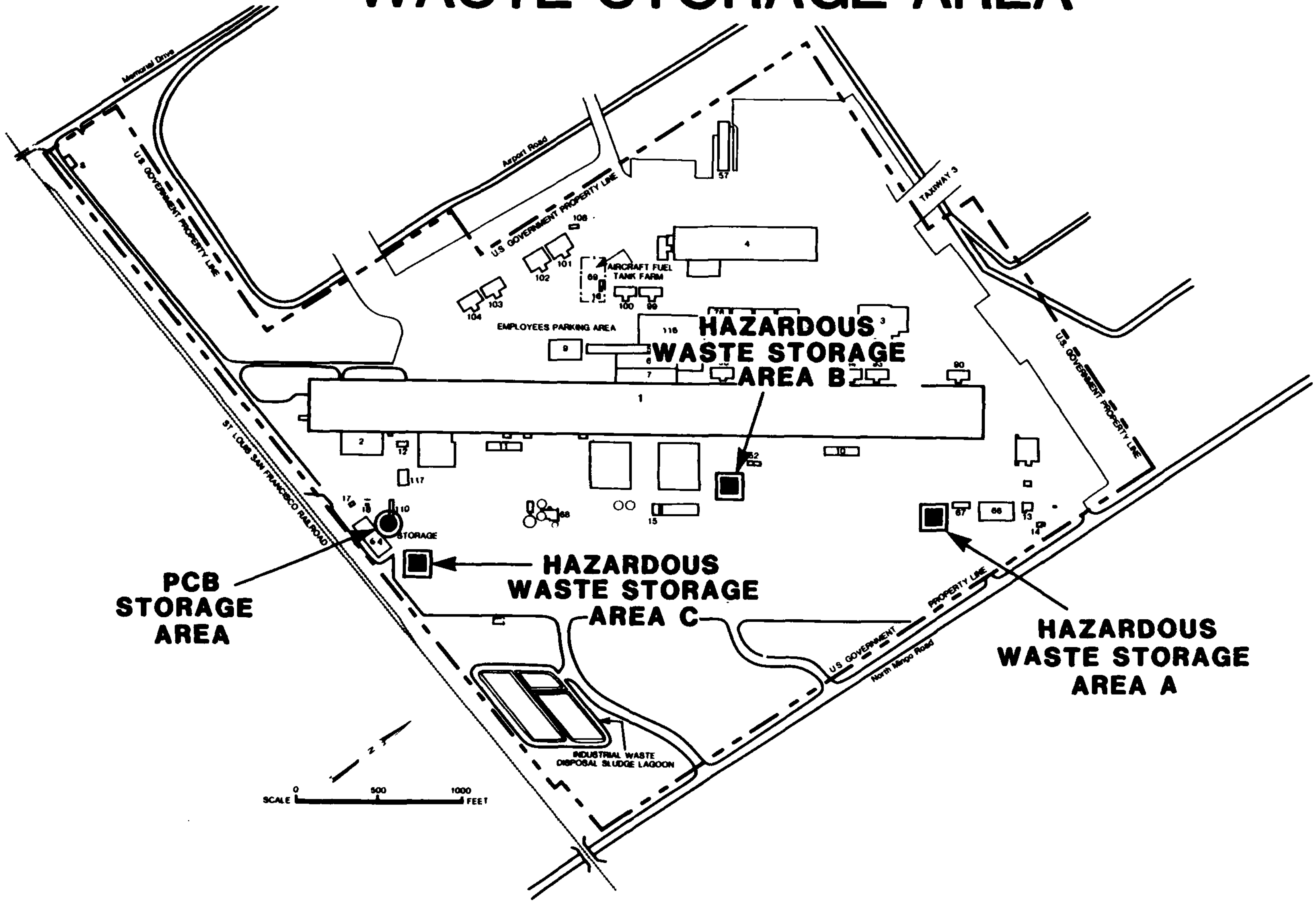
Storage of hazardous wastes at Air Force Plant No. 3 occurs primarily at four locations, as described in Table 4.2. Figure 4.2 shows the location of each storage site.

Hazardous Waste Storage Areas A and B are areas in which McDonnell Douglas stores drummed waste materials prior to a contractor transporting them off the plant site for disposal. Hazardous Waste Storage Area A has been used since 1964 and Hazardous Waste Storage Area B has been used since 1976. These areas are open-air areas with the drums placed

TABLE 4.2
SUMMARY OF WASTE STORAGE AREAS
AIR FORCE PLANT 3

Air Designation	Responsible Unit	Capacity	Materials Stored	Period of Operation
Hazardous Waste Storage Area A	McDonnell Douglas	200 drums	Waste fuel, oil, solvent-paint mixture.	1964 - present
Hazardous Waste Storage Area B	McDonnell Douglas	100 drums	Chemical mill sludge, paint booth wastes, vapor degreaser sludge, water treatment resins.	1976 - present
Hazardous Waste Storage Area C	Rockwell International	100 drums	Solvent-paint sludge, waste coolant oil.	1962 - present
PCB Storage Area	McDonnell Douglas	--	PCB contaminated transformers and equipment.	1980 - present

USAF PLANT NO. 3
WASTE STORAGE AREA



SOURCE: USAF PLANT NO. 3 INSTALLATION DOCUMENTS

on wooden pallets on the ground. Similar wastes are stored on adjoining pallets.

The salvage yard (Hazardous Waste Storage Area C) is the drummed waste storage area utilized by Rockwell International. The salvage yard is an open area in which drums are placed on pallets on the ground. Similar wastes are stored on adjoining pallets. Waste coolant and oil are stored in a 1,700 gallon fiberglass tank in the drum storage area. There have been three areas within and adjacent to the present salvage yard boundaries which have been used by Rockwell International for waste storage. From 1962 to 1964, an area about 1/4 the size of the present salvage yard and immediately east of the present yard was used. From 1964 to 1968, a similarly sized area adjacent to the east side of the present area was used. Since 1968, the larger area, which is the present salvage yard, has been used.

PCB contaminated transformers are stored in Building 304. No leaks or spills have been reported at this site and there was no evidence of any leaks or spills observed.

A tour was conducted of these four sites during the plant visit. The soils at Hazardous Waste Storage Sites A, B, and C were discolored, an indication that spills and leaks have occurred. There was information in the McDonnell Douglas environmental files concerning leakage of oil from transformers stored next to Hazardous Waste Storage Site A. The the PCB-contaminated transformers had been relocated to the PCB storage area in 1982 and the contaminated soil was disposed of by an off-site contractor.

Spills

Small fuel spills have occurred in several areas of the plant property. These spills are primarily attributed to fuel transfer and aircraft refueling operations. These spills typically occurred on paved areas and were promptly cleaned up. No significant environmental contamination is attributed to these spills.

Two large spills have occurred at Air Force Plant 3. During the late 1960's, a tank mounted on a truck located inside the main building sprang a leak while the truck was being filled with nitric acid waste. Several hundred gallons of nitric acid waste was estimated to have been released onto the concrete floor within the building. The material was washed with hoses into the drains which feed to the industrial waste treatment plant. The diluted acid was neutralized at the treatment plant. Due to the nature of the spill and its location, no significant environmental contamination is attributed to this incident.

A second incident, on January 2, 1980, resulted in the release of about 500 gallons of mixed waste acid. In this incident, a waste acid tank at the industrial waste treatment plant sprang a leak. A portion of the acid flowed onto an east-side parking lot. The spill was neutralized and washed to the storm sewer which discharged to Mingo Creek via Outfall 004. No significant permanent environmental contamination is associated with this incident.

Description of Past On-Site Treatment and Disposal Methods

The facilities on Air Force Plant No. 3 which have been used for the treatment and disposal of waste can be categorized as follows:

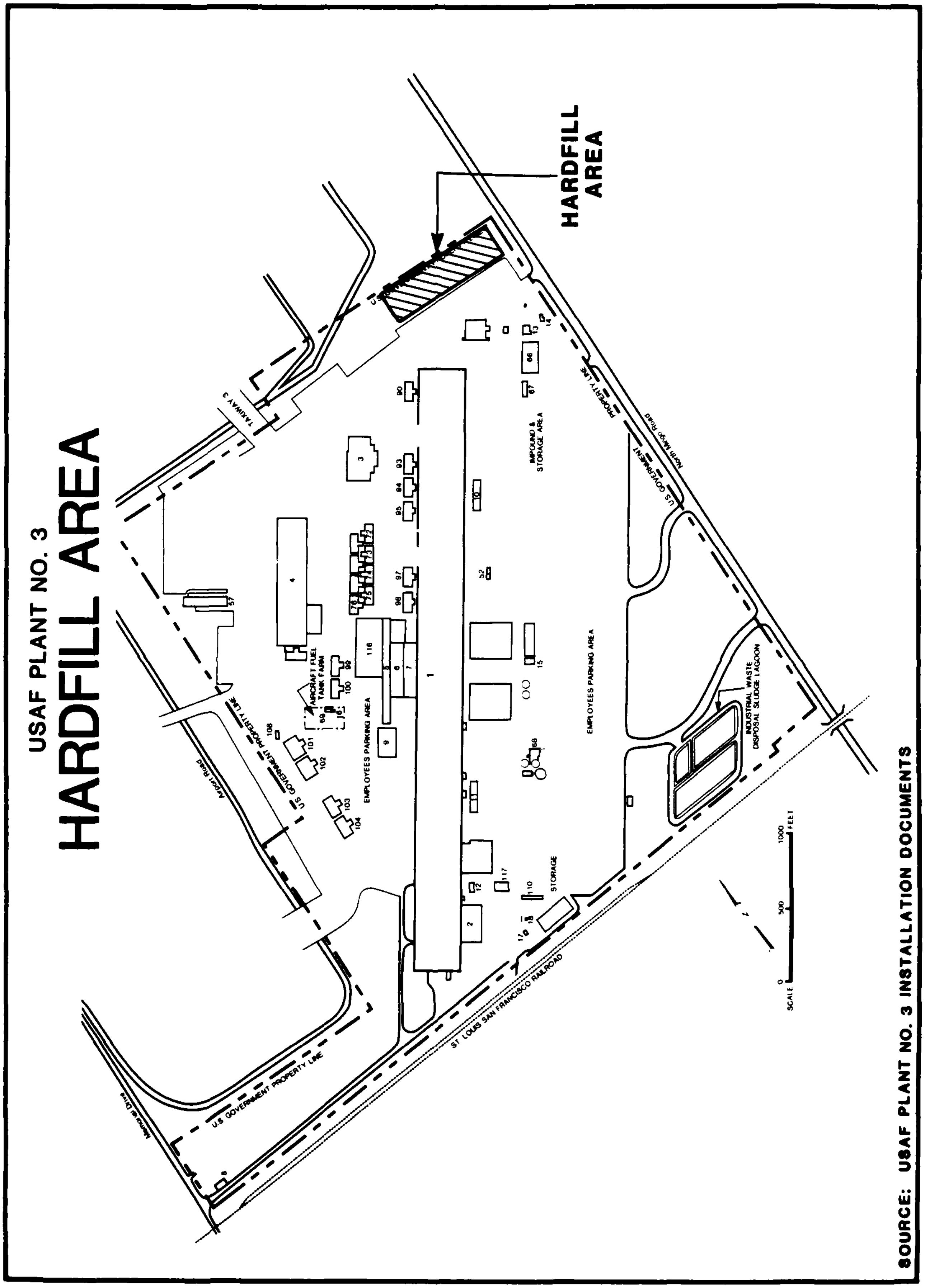
- Hardfill
- Industrial Waste Treatment
- Surface Impoundments
- Refuse Incinerator
- Low-Level Radioactive Waste Disposal Site
- Sanitary Sewer System
- Surface Drainage System

Hardfill

The area in the northeast corner of the plant site (Figure 4.3) was used for disposal of construction debris and other miscellaneous materials during the 1940's and 1950's. This was a low area that was filled between the plant and an unnamed stream. It is suspected that this area was used for disposal of miscellaneous trash during the period of 1942-1946. Burning was reported to have taken place at the north end of Building 1 and ash from the incinerator was also disposed of in this area during the initial plant operation. When the plant was deactivated in 1946, some of the waste material from equipment shut down may have been disposed of at the hardfill site.

When the plant was reactivated in the early 1950's, much of the construction debris was placed in the hardfill. The hardfill was also

FIGURE 4.3


USAF PLANT NO. 3
HARDFILL AREA
HARDFILL AREA
TAXIWAY 3
AIRCRAFT FUEL TANK FARM
EMPLOYEES PARKING AREA
EMPLOYEES PARKING AREA
IMPOUND & STORAGE AREA
STORAGE
INDUSTRIAL WASTE DISPOSAL SLUDGE LAGOON
U.S. GOVERNMENT PROPERTY LINE
U.S. GOVERNMENT PROPERTY LINE
U.S. GOVERNMENT PROPERTY LINE
ST LOUIS SAN FRANCISCO RAILROAD
North Mingo Road
Airport Road
SCALE
0
500
1000
FEET
SOURCE: USAF PLANT NO. 3 INSTALLATION DOCUMENTS

reported as receiving sludge from fuel tank cleaning, fuel filters, and ash from the incinerator. Burning of trash also took place in the hardfill area. In 1959 the concrete apron was extended at the north end of Building 1 and the hardfill area was closed and covered with soil. The size of the hardfill is estimated as 200 ft by 800 ft and depth as about 10 ft.

In 1967 a small holding pond was constructed over the south central part of the hardfill. The pond was used for a short time as a holding and settling basin for rinse water from wing tank desealing and cleaning. The waste contained some chlorinated hydrocarbon solvent and sealant sludge. After completing this operation the pond was covered over. The hardfill site was inspected during the on-site visit. The area is well graded and covered with soil and vegetation. There was no evidence of waste at the surface. Some vegetative stress was noted along the south side but this was probably due to oil leakage from old equipment being stored next to the hardfill.

Industrial Waste Treatment Plant

An industrial waste treatment plant is located on the east site as the plant (Figure 4.4) and is operated by Rockwell International. The permits for the waste treatment plant are maintained by McDonnell-Douglas Corporation. The treatment plant was installed in 1952 and has undergone several modifications, primarily addition of several waste chemical storage tanks and one final treatment basin.

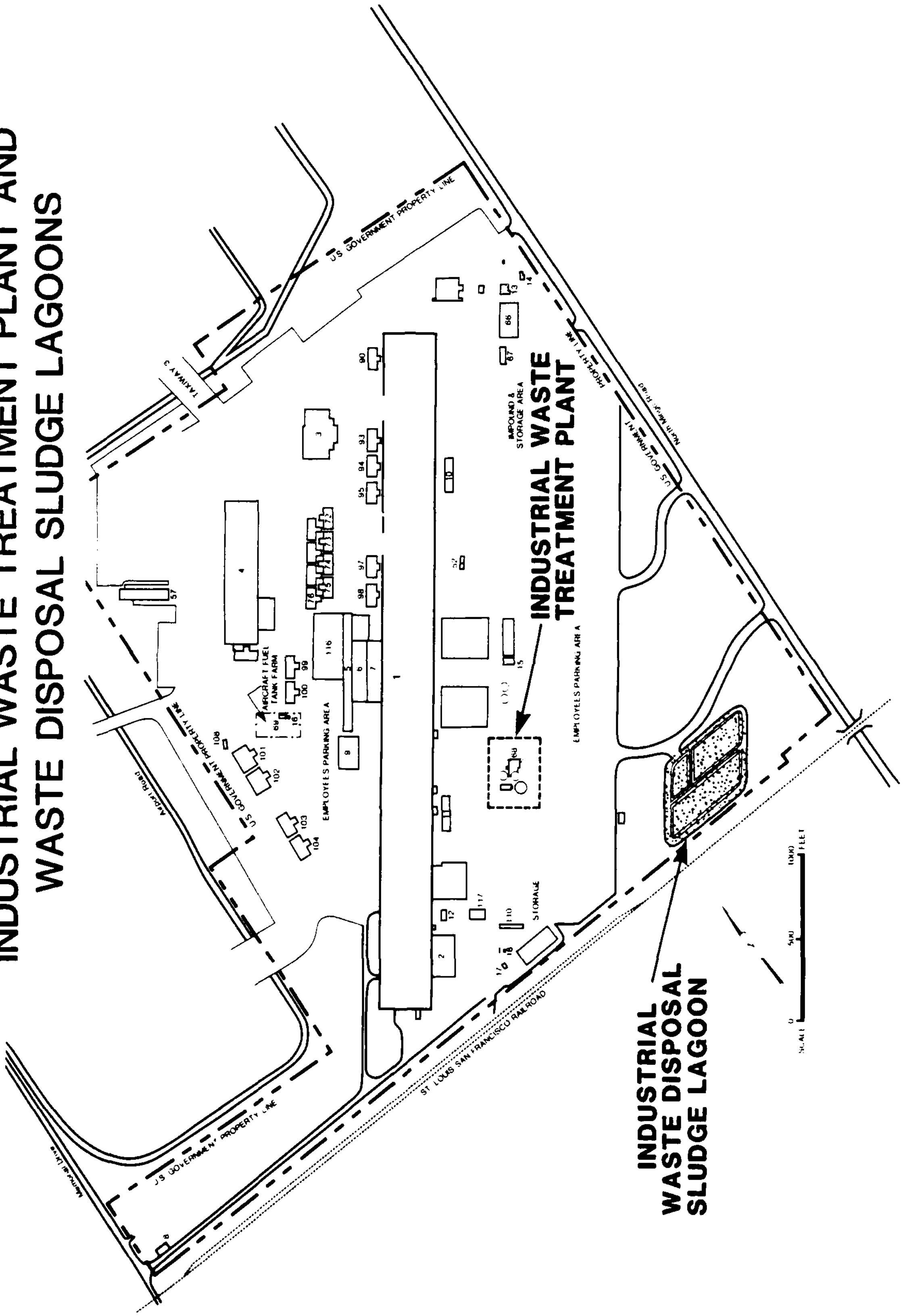
The treatment plant was designed for cyanide and chromium treatment. Wastes are collected in two separate sewer systems; acid-chrome, and alkali cyanide. These separate sewers discharge into two separate sumps at the plant. The principal treatment includes oxidation of cyanides with chlorine and reduction of hexavalent chrome to trivalent chrome with sulfur dioxide. After the oxidation and reduction are accomplished separately, the wastes are combined, made alkaline with lime, clarified, recarbonated to remove excess calcium alkalinity, and settled. Effluent from the plant (Outfall 003) is to Bird Creek, flowing to the east to the Verdigris River which empties into the Arkansas River.

Flow rates to the treatment plant average 125,000 to 150,000 gallons per day, of which about 70 to 80 percent is acidic. Clarifier

FIGURE 4.4

USAF PLANT NO. 3

INDUSTRIAL WASTE TREATMENT PLANT AND WASTE DISPOSAL SLUDGE LAGOONS



SOURCE: USAF PLANT NO. 3 INSTALLATION DOCUMENTS

sludge is pumped to the industrial waste disposal sludge lagoons for storage. Clarifier sludge flow rates average about 5,000 gallons per day.

Surface Impoundments

Surface impoundments at Air Force Plant No. 3 consist of two industrial waste sludge lagoons located at the southeast corner of the plant. These surface impoundments are used for disposal of sludge from the industrial waste treatment plant. During the 1950's and 1960's, these lagoons were occasionally used for disposal of some shop wastes. These two lagoons have been in operation since 1952, and have a capacity of approximately 5.5 million gallons each. During the 1960's, the lagoons were cleaned and trees growing in the south lagoon were removed. Ground-water monitoring wells were installed in 1982; no ground-water contamination has been found. Details of the ground-water monitoring program are discussed in Chapter 3.

Refuse Incineration

From the time the plant started up in 1942 through 1959, general refuse collected from the plant operations was incinerated at Building 14 (Figure 4.5). The ash from the incinerator was disposed of in the hardfill area located north of the incinerator. During hot weather periods the refuse was sometimes burned in a portable cage in the hardfill area. During the site visit by the project team, the remains of the cage were found north of the hardfill area.

A trash compactor was constructed in 1959 at Building 14. Since 1960, the general refuse from the plant has been transported to the compactor by plant personnel. After compaction of the waste, a contractor has hauled the waste to a landfill off the plant site.

Low-Level Radioactive Waste Burial Site

Low-level radioactive objects such as instrument dials and vacuum tubes were removed from aircraft undergoing maintenance and disposed of on the plant property during the 1950's and 1960's. The disposal site for the low-level radioactive waste is located in the southeast corner of the property east of the industrial waste sludge lagoons (Figure 4.6). The waste objects were placed in lead containers. A pit about 10 feet deep was excavated and the lead containers were placed in the pit and concrete poured around the containers. Soil was then placed over

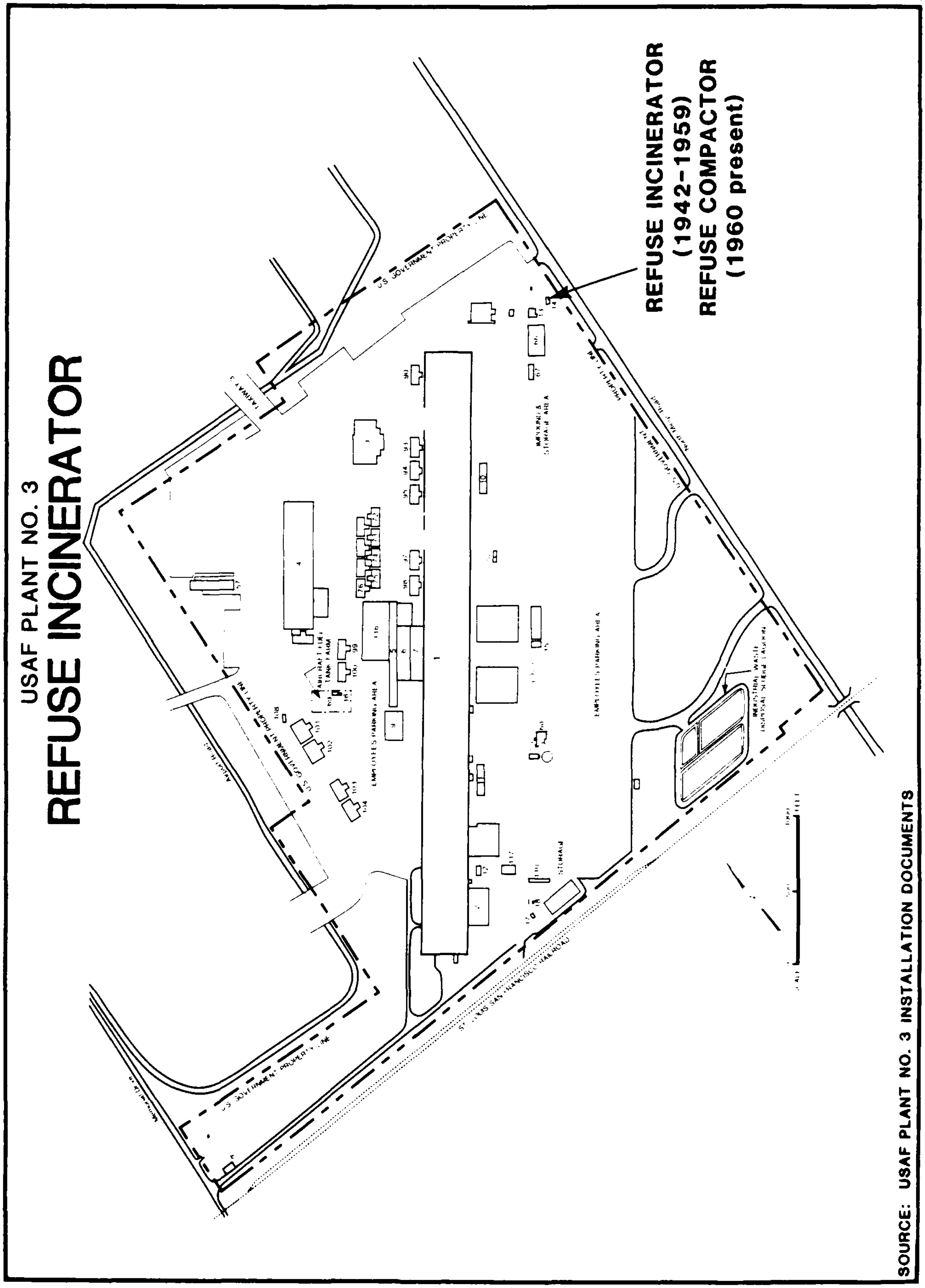


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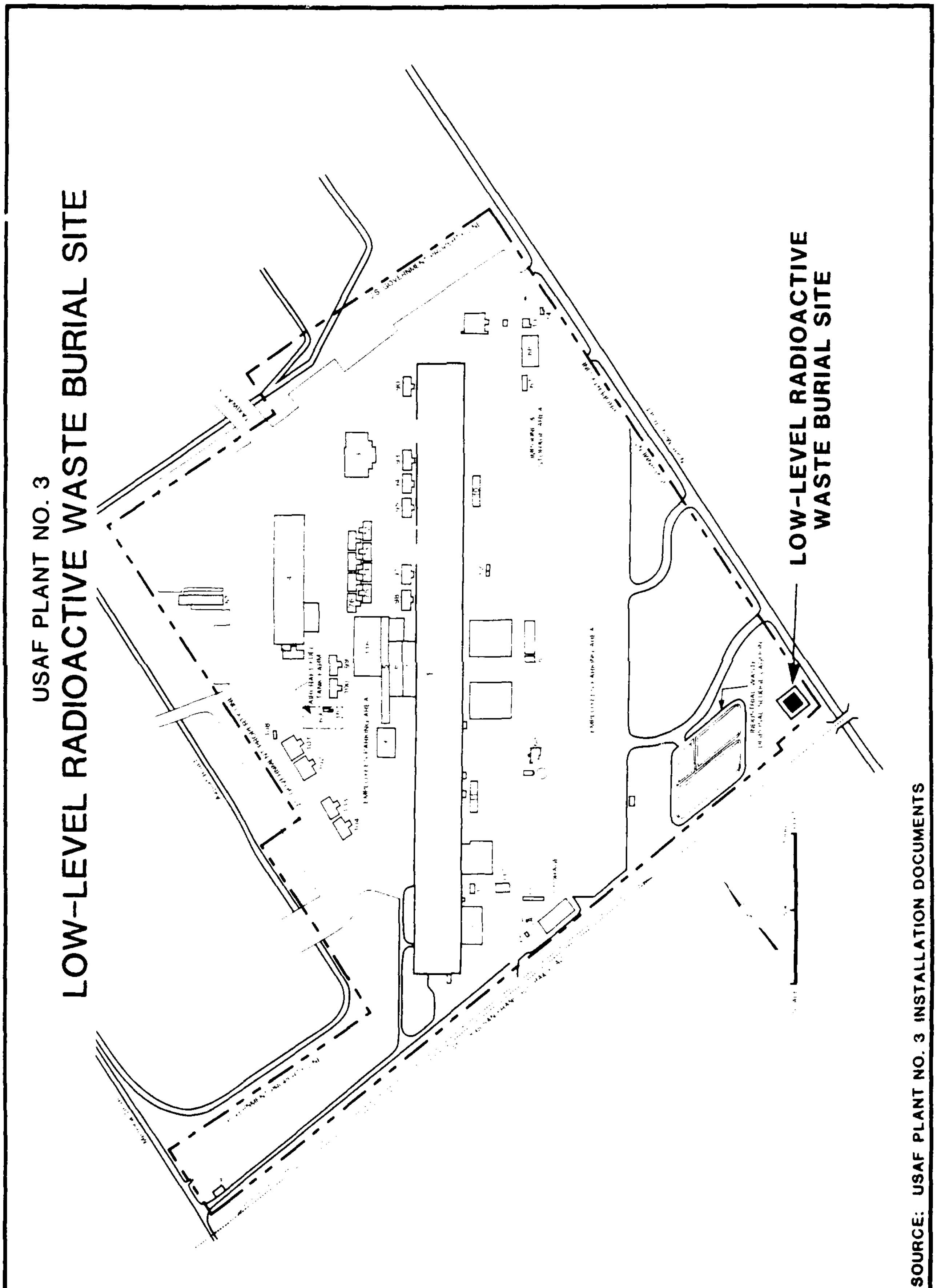
FIGURE 4.6


USAF PLANT NO. 3
LOW-LEVEL RADIOACTIVE WASTE BURIAL SITE
LOW-LEVEL RADIOACTIVE
WASTE BURIAL SITE
SOURCE: USAF PLANT NO. 3 INSTALLATION DOCUMENTS

the pit. A fence has been constructed around the site with warning signs. The area has been monitored and radiation levels have not increased above background level.

Sanitary Sewer System

Sanitary sewage from Plant 3 is piped to the City of Tulsa's Northside treatment facility. No treatment of sanitary wastes occurs at the plant site.

Surface Drainage System

Storm waters from Plant 3 flow into a drainage system which feeds to Outfalls 001, 002, 003 and 004 (USEPA and OWRB permitted outfalls) and a fifth outfall which is surface drainage only and is not regulated by permits. The outfalls discharge to Bird Creek and Mingo Creek. A detailed description of the drainage system is contained in Chapter 3.

EVALUATION OF PAST DISPOSAL ACTIVITIES AND FACILITIES

The review of past operation and maintenance functions and past waste management practices at Air Force Plant No. 3 has resulted in the identification of 12 sites which were initially considered as areas of concern with regard to the potential for contamination, as well as the potential for the migration of contaminants. These sites were evaluated using the Decision Tree Methodology referred to in Figure 1.1. Those sites which were considered as not having a potential for contamination were deleted from further consideration. Those sites which were considered as having a potential for the occurrence of contamination and migration of contaminants were further evaluated using the Hazard Assessment Rating Methodology (HARM). Table 4.3 identifies the decision tree logic used for each of the areas of initial concern.

Based on the decision tree logic, 5 of the 12 sites originally reviewed were not considered to warrant evaluation using the Hazard Assessent Rating Methodology. The rationale for omitting these five sites from HARM evaluation is discussed below.

There was no evidence of or information indicating that spills have occurred in the PCB storage area. Therefore, there is no potential for contaminant migration at this site.

The acid spill and waste spill incidences occurred on concrete or paved areas. The spilled material was either cleaned up, neutralized,

TABLE 4.3

SUMMARY OF DECISION TREE LOGIC FOR AREAS OF INITIAL ENVIRONMENTAL CONCERN AT AIR FORCE PLANT NO. 3

Site Description	Potential for Contamination	Potential for Contaminant Migration	HARM Rating
Fire Protection Training Area	Yes	Yes	Yes
Hazardous Waste Storage Area A	Yes	Yes	Yes
Hazardous Waste Storage Area B	Yes	Yes	Yes
Hazardous Waste Storage Area C	Yes	Yes	Yes
PCB Storage Area	Yes	No	No
Fuel Tank Leaks	Yes	No	No
Acid Spill	Yes	No	No
Waste Spill	Yes	No	No
Hardfill	Yes	Yes	Yes
Industrial Waste Disposal Sludge Lagoons	Yes	No	No
Refuse Incinerator	No	No	No
Low-Level Radioactive Waste Burial Site	Yes	Yes	Yes

and/or washed into the sewer system. No significant residue has been left on the plant site. Therefore, there is no potential for contaminant migration from these sites.

The refuse incinerator was used to burn plant trash. Some hazardous material may have been mixed in the trash but the incinerator would have rendered the material harmless. Therefore, the potential for contamination from this site does not exist because no contaminants are present.

The underground tank leaks in the tank farm resulted in ground water leaking into the fuel tanks. No leakage of fuel out of the tanks was known to have occurred. Therefore, there is no potential for contaminant migration from this site.

A ground-water monitoring program has been implemented around the industrial waste disposal sludge lagoons. The results from the monitoring program were presented and discussed in Chapter 3. No ground-water contamination has been found; therefore, no further investigation is needed at this site.

The remaining seven sites identified in Table 4.3 were evaluated using the Hazard Assessment Rating Methodology. The HARM process takes into account characteristics of potential receptors, waste characteristics, pathways for migration, and specific characteristics of the site related to waste management practices. The details of the rating procedures are presented in Appendix F. Results of the assessment for the sites are summarized in Table 4.4. The HARM system is designed to indicate the relative need for follow-on action. The information presented in Table 4.4 is intended for assigning priorities for further evaluation of the Air Force Plant No. 3 disposal areas (Chapter 5, Conclusions, and Chapter 6, Recommendations). The rating forms for the individual waste disposal sites at Air Force Plant No. 3 are presented in Appendix G. Photographs of some of the key disposal sites are included in Appendix E.

TABLE 4.4
SUMMARY OF HARM SCORES
FOR POTENTIAL CONTAMINATION SOURCES
AT AIR FORCE PLANT NO. 3

Rank	Site	Receptor Subscore	Waste Characteristics Subscore	Pathway Subscore	Waste Management Factor	Total Score
1	Hazardous Waste Storage Area A	41	60	48	1.0	50
2	Hazardous Waste Storage Area B	41	60	48	1.0	50
3	Hazardous Waste Storage Area C	41	60	48	1.0	50
4	Hardfill Area	41	50	48	1.0	46
5	Fire Protection Training Area	38	48	48	1.0	45
6	Low-Level Radio-active Waste Disposal Area	38	30	48	0.95	37

Source: Engineering-Science

CHAPTER 5

CONCLUSIONS

The goal of the IRP Phase I study is to identify sites where there is potential for environmental contamination resulting from past waste disposal practices and to assess the probability of contaminant migration from these sites. The conclusions given below are based on field inspections, review of records and files, review of the environmental setting, and interviews with plant personnel, past employees, and state government employees. Table 5.1 contains a list of the potential contamination sources identified at Air Force Plant No. 3 and a summary of the HARM scores for those sites. Information pertaining to these sites is summarized below and follow-on recommendations are presented in Chapter 6.

HAZARDOUS WASTE STORAGE SITES A, B AND C

There is sufficient evidence that Hazardous Waste Storage Sites A, B, and C have a potential for creating environmental contamination and follow-on investigations are warranted. Site A was used for storage of hazardous waste from 1964 to 1983 (present), Site B was used from 1976 to 1983 and Site C was used from 1962 to 1983. Drums of waste have been stored on pallets placed on the ground at all three sites. There is discolored soil in these areas indicating that leaks and spills have occurred. The soil is not very permeable and the area is not considered to be an aquifer recharge zone. Contaminant migration may more likely occur with surface runoff. These three sites all received a HARM score of 50.

HARDFILL AREA

There is insufficient evidence to indicate that the hardfill area has a potential for creating environmental contamination and follow-on investigation is not recommended. This site was used primarily for

TABLE 5.1
SITES EVALUATED USING THE HAZARD ASSESSMENT
RATING METHODOLOGY
AIR FORCE PLANT NO. 3

Rank	Site	Operating Period	Final HARM Score
1	Hazardous Waste Storage Area A	1964-Present	50
2	Hazardous Waste Storage Area B	1976-Present	50
3	Hazardous Waste Storage Area C	1962-Present	50
4	Hardfill Area	1942-1946 and 1952-1959	46
5	Fire Protection Training Area	1951-Present	45
6	Low-Level Radioactive Waste Diposal Area	1952 - 1969	37

disposal of construction debris from 1942 through 1959. Some wastes are suspected of being disposed of and burned at the hardfill. Other materials such as ash were disposed of at the site but these materials are inert and present little chance of creating leachate. Small quantities of waste such as tank sludges were also disposed of at this site. The site is closed and has a soil cover with vegetation growing on the surface. Considering the area has a net precipitation of minus 14 inches, it is doubtful that any significant quantity of leachate would be generated from this site. The site received a HARM score of 46.

FIRE PROTECTION TRAINING AREA

There is insufficient evidence to indicate that the fire protection training area has a potential for creating environmental contamination and follow-on investigation is not recommended. This site was used infrequently from 1951 to the present. Soils in the area have a low permeability and the area is not considered to be an aquifer recharge zone. The most likely contaminant migration would be surface overflow during training exercises. This site received a HARM score of 45.

LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA

The is insufficient evidence to indicate that the low level radioactive waste disposal area has a potential for creating environmental contamination and follow-on investigation is not recommended. This site was used for disposal of low-level radioactive objects (e.g. instrument dials) from aircraft undergoing maintenance at the plant. The site was operated from 1952 through 1969. The waste objects are in lead containers encased in concrete buried about 10 feet deep. The site is fenced and has warning signs. It is unlikely that any contaminated leachate would be generated from this site. The site received a HARM score of 37.

CHAPTER 6

RECOMMENDATIONS

Six sites were identified at Air Force Plant No. 3 as having the potential for environmental contamination. These sites have been evaluated using the HARM system which assesses their relative potential for contamination. Three of the sites were determined to have sufficient evidence to indicate potential for environmental contamination. Additional data concerning these sites will be required in order to clearly ascertain whether or not these sites have contributed environmental contamination. Therefore, the following recommendtions have been developed for each of the sites. There was insufficient evidence at the other three sites to warrant further investigation.

PHASE II MONITORING

The subsequent recommendations are made to further assess the potential for environmental contamination from waste disposal areas at Air Force Plant No. 3. The recommended actions are generally one-time sampling programs to determine if contamination does exist at the site. If contamination is identified, the sampling program may need to be expanded to define the extent of contamiantion. The recommended monitoring program, including analytical parameters, is summarized in Table 6.1.

Two continuous core soil borings should be collected in each of the Hazardous Waste Storage Sites, A, B, and C. The boring should be located in areas showing visual contamination. The borings should extend to the top of shale or to a minimum depth of five feet. A water extraction should be performed on the top six inches of soil and the sample analyzed for total organic halogens (TOX), phenols, and oil and grease. PCB analyses should also be performed on the sample collected from Site A. If contamination is found, additional analyses should be conducted on the next foot of sample or until no further contaminants are identified.

TABLE 6.1
RECOMMENDED MONITORING PROGRAM FOR PHASE II
IRP AT AIR FORCE PLANT NO. 3

Site (Rating Score)	Recommended Monitoring	Recommended Analytical Parameters
Hazardous Waste Storage Site A (53)	Collect two continuous soil borings in areas with apparent contamination. Borings should five feet deep or to top of shale. Perform water extraction on top six inches of soil. If contamination found proceed to next lower core sample and continue until depth of contamination defined.	Total Organic Halogens Oil and Grease Phenol PCB's
Hazardous Waste Storage Site B (53)	Collect two continuous soil borings in areas with apparent contamination. Borings should five feet deep or to top of shale. Perform water extraction on top six inches of soil. If contamination found proceed to next lower core sample and continue until depth of contamination defined.	Total Organic Halogens Oil and Grease Phenol
Hazardous Waste Storage Site C (53)	Collect two continuous soil borings in areas with apparent contamination. Borings should five feet deep or to top of shale. Perform water extraction on top six inches of soil. If contamination found proceed to next lower core sample and continue until depth of contamination defined.	Total Organic Halogens Oil and Grease Phenol

TABLE OF CONTENTS

APPENDIX A

BIOGRAPHICAL DATA

2

Biographical Data

ERNEST J. SCHROEDER

Environmental Engineer
Manager, Solid and Hazardous Waste

PII Redacted

[redacted]

Education

B.S. in Civil Engineering, 1966, University of Arkansas, Fayetteville, Arkansas
M.S. in Sanitary Engineering, 1967, University of Arkansas, Fayetteville, Arkansas

Professional Affiliations

Registered Professional Engineer (Arkansas No. 3259, Georgia No. 10618, Texas No. 33556 and Florida No. 0029175)
Water Pollution Control Federation
American Academy of Environmental Engineers

Honorary Affiliations

Chi Epsilon

Experience Record

1967-1976 Union Carbide Technical Center, Engineering Department, South Charleston, West Virginia (1967-1968). Project Engineer. Responsible for environmental protection engineering projects for various organic chemicals and plastics plants. Conducted industrial waste surveys, landfill design, and planning for plant environmental protection programs; evaluated air pollution discharges from new sources; reviewed a wastewater treatment plant design; and participated on a project team to design a new chemical unit.

Union Carbide Corporation, Environmental Protection Department, Texas City, Texas (1969-1975). Project Engineer and Engineering Supervisor. Responsible for various aspects of plant pollution abatement programs, including preparation of state and federal permits for wastewater treatment activities.

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ERNEST J. SCHROEDER (Continued)

Operations Representative on $8 million regional wastewater treatment project and member of design team which made the initial site selection and process evaluation and recommendation. Participated in contract negotiations, process and detailed engineering design, construction of the facilities, preparation of start-up manuals, operator training, and the start-up activities. Designated as Project Engineer after start-up on expansion to original waste treatment unit.

Engineering Supervisor responsible for operation of wastewater treatment facilities including collection system, sampling and monitoring programs, spill control and clean-up, primary waste treatment, wastewater transfer system, biological waste treatment, and waste treatment pilot plants. Developed odor control program which successfully reduced odor emissions and represented Union Carbide at a public hearing on community odor problems.

Led special projects such as an excess loss control program to reduce water pollution losses; sewer segregation program involving coordination and reporting of 38 projects for the separation of contaminated and non-contaminated water; and sludge disposal program to develop long-term sludge disposal alternatives and recover land in present sludge landfill area. Developed improved methods of sampling and continuous monitoring of wastewater.

Union Carbide Corporation, Environmental Protection Project Engineer, Toronto, Ontario, Canada (1975-1976). Responsible for the overall environmental permitting, engineering design, construction and start-up of waste treatment systems associated with a new refinery.

1976-Date — Engineering-Science, Inc., Project Manager (1976-1978). Responsible for several industrial wastewater projects including the following: wastewater investigation to characterize sources of waste streams in a chemical plant and to develop methods to reduce the wastes, sludge settling studies to evaluate settling characteristics of activated sludge at a chemical plant, development of a process document for the design and operation of a wastewater treatment facility at a petrochemical complex, wastewater treatment evaluation which included characterization of wastewater, unit process evaluation, inhibition studies, design review, operations review, preparation of operations manual, operator training and providing operating assistance for waste treatment facilities, various biological treatability studies and bench-scale and pilot-scale evaluation of advanced waste treatment

ERNEST J. SCHROEDER (Continued)

technologies such as granular carbon adsorption, multi-media filtration, powdered activated carbon treatment, ion exchange and ozonation.

Project Manager for hazardous waste disposal projects involving waste characterization, development of criteria for disposal of hazardous waste, site investigation, preparation of permits, detailed design, construction of facilities and spill clean-up activities.

Deputy Project Manager for industry-wide pilot plant study of advanced waste treatment in the textile industry. Technologies evaluated included coagulation/clarification, multi-media filtration, granular carbon adsorption, powdered activated carbon treatment, ozonation and dissolved air flotation.

Engineering-Science, Inc., Manager of the Industrial Waste Group in the Atlanta, Georgia office (1978-1980). Responsible for the supervision of industrial waste project managers and project engineers and the management of industrial waste studies conducted in the office. Also directly involved in project management consulting with clients on environmental studies and environment assessment projects, e.g., project manager for several spill control and wastewater treatability projects and for a third-party EIS for a new phosphate mine in Florida.

Engineering-Science, Inc., Manager of Solid and Hazardous Waste Group in the Atlanta, Georgia office (1980-date). Responsible for the supervision of solid and hazardous waste project managers and project engineers and the management of solid and hazardous waste projects in the office. Project activities have included permit and regulatory assistance, environmental audits, waste management program development, delisting partitions, ground-water monitoring, landfill evaluations, landfill closure design, hazardous waste management, waste inventory, waste recovery/recycle evaluation, waste disposalalternative evaluation, transportation evaluation, and spill control and countermeasure planning.

Project Manager for twelve Phase I Installation Restoration Program projects for the U.S. Air Force. The objective of this program is to audit past hazardous waste disposal practices that could result in migration of contaminants and recommend priority sites requiring further investigation. Also conducted environmental audits (air, water and solid

ERNEST J. SCHROEDER (Continued)

waste) at over ten industrial facilities. Project manager for a contamination assessment and hazardous waste site cleanup being conducted for an industrial client as part of a consent degree agreement. Project manager for site investigation and contamination assessment projects at multiply hazardous waste sites in the northeast.

Publications and Presentations

Schroeder, E. J., "Filamentous Activated Sludge Treatment of Nitrogen Deficient Waste," research paper submitted in partial fulfillment of the requirements for MSCE degree, 1967.

Schroeder, E. J. and Loven, A. W., "Activated Carbon Adsorption for Textile Wastewater Pollution Control," Symposium Proceedings: Textile Industry Technology, December 1978, Williamsburg, VA.

Schroeder, E. J., "Summary Report of the BATEA Guidelines (1974) Study for the Textile Industry," North Carolina Section of AWWA/WPCA, Pinehurst, North Carolina, November 1979.

Mayfield, R. E., Sargent, T. N. and Schroeder, E. J., "Evaluation of BATEA Guidelines (1974) Textiles," U.S. EPA Report, Grant No. R-804329, February 1980.

Storey, W. A. and Schroeder, E. J., "Pilot Plant Evaluation of the 1974 BATEA Guidelines for the Textile Industry," Proceedings of the 35th Industrial Waste Conference, Purdue University, May 1980.

Pope, R. L., and Schroeder, E. J., "Treatment of Textile Wastewaters Using Activated Sludge With Powdered Activated Carbon," U.S. EPA Report, Grant No. R-804329, December 1980.

Schroeder, E. J., "Industrial Solid Waste Management Program to Comply with RCRA," Engineering Short Course Instructor, Auburn University, October 1980.

Schroeder, E. J., "Technical and Economic Impact of RCRA on Industrial Solid Waste Management, Florida Section, American Chemical Society, May 1981.

Schroeder, E. J. and Sargent, T. N., "Hazardous Waste Site Rating Systems," Textile Wastewater Treatment and Air Pollution Control Conference, January 1983.

Biographical Data

ROBERT S. McLEOD

Hydrologist

PII Redacted

[redacted]

Education

B.S. in Civil Engineering, 1962, University of Illinois
M.S. in Civil Engineering, 1965, University of Wisconsin

Professional Affiliations

Registered Professional Engineer (Georgia No. CE12684)
American Society of Civil Engineers
American Water Resources Association
National Water Well Association

Experience Record

1962-1964 U.S. Army Corps of Engineers. Staff Engineer. Involved in a low-head dam rehabilitation project. Monitored dredging operations for turning basins in small harbors.

1964-1980 U.S. Geological Survey. Project Chief. Supervised a study on the effects of using groundwater to maintain lake levels which involved evaluation of various hydrologic factors in relation to water-level fluctuations and description of the hydrologic system response from pumping groundwater into the lake. Conducted a study on probable future effects of groundwater pumping on an aquifer system using three-dimensional digital-modeling techniques to predict head declines in the water table and underlying deep aquifer and reductions in flow of nearby streams. Supervised a study to evaluate groundwater and surface water hydrology and hydrological changes caused by construction of a reservoir and a floodwater retention structure in a small basin. Developed a digital-computer program which when applied to two-dimensional, confined groundwater flow problems can predict changes in flow caused by pumping. Developed automated data files and support programs for storing and displaying various types of hydrologic records.

0682#

Robert S. McLeod (Continued)

Project Hydrologist. Investigated surface and groundwater supplies in an area of near-surface crystalline rock to determine availability of groundwater as a source of industrial and municipal supplies. Refined flood-frequency relationships for streams to determine 50-year flood levels. Conducted a study on the relationship between low-flow characteristics and basin characteristics to determine magnitude and frequency of low flows from streams. Involved in basic records collection of surface water and groundwater data. Surface water data were collected to aid in defining the statistical properties of and trends in the occurrence of water in streams and lakes. Groundwater data were collected on water-level fluctuations in principal aquifers to monitor natural and man-induced changes and to estimate the severity of climatic cycles on the availability of groundwater.

1980-1982 Law Engineering Testing Company, Atlanta, Georgia. Project Manager. Responsible for coal hydrology studies in Alabama involving geologic and hydrologic analyses of mining sites, descriptions of site geology, and estimates on probable hydrologic consequences of mining as part of the Office of Surface Mining Small Operator Assistance Program.

Director of Analysis and Reporting/Hydrogeologist. Evaluated the feasibility of using salt domes in the Gulf Coast area to store high-level nuclear wastes. Defined site geology, hydrology, and groundwater flow, direction, and rates for contaminant transport.

1982-Date Engineering-Science. Hydrologist. Responsible for groundwater monitoring studies, aquifer testing, contaminant migration studies, and modeling of groundwater systems.

Publications

"Groundwater Occurrence and Movement Related to Aquifer System Models," Workshop Proceedings, Indiana Water Resources - Future Problems and Needs, Purdue University, May 10-11, 1973.

"A Digital Computer Model for Estimating Drawdowns in the Sandstone Aquifer System in Dane County, Wisconsin," Wisconsin Geological and Natural History Survey Information Circular 28, and presented at the National Water Well Association Midwest Conference, September 1973.

Robert S. McLeod (Continued)

"A Digital Computer Model for Estimating Hydrologic Changes in the Aquifer System in Dane County, Wisconsin," Wisconsin Geological and Natural History Information Circular 30, and presented at the American Water Resources Association Tenth National Convention, August 1974.

Papers and Presentations

"Relation Between Groundwater Pumping and Streamflow in the Yahara River Watershed, Wisconsin," presented at the Madison Hydrology Club, November 1978.

"Groundwater Modeling Techniques for Managing Aquifer Systems," presented at the University of Wisconsin Continuing Education Sanitary Engineering Institute, March 1979.

"Water Use Data Collection Program in Wisconsin," presented at the Midwest Groundwater Conference, November 1979.

"Groundwater Flow in the Vicinity of Richton and Cypress Creek Salt Domes, Perry County, Mississippi," presented at the Fifth Southeastern Groundwater Conference, November 1981.

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BIOGRAPHICAL DATA

Eric Heinman Snider

Senior Chemical Engineer

PII Redacted

[redacted]

Education

B.S. in Chemistry (Magna Cum Laude), 1973, Clemson University, Clemson, S.C.
M.S. in Chemical Engineering, 1975, Clemson University, Clemson, S.C.
Ph.D. in Chemical Engineering, 1978, Clemson University, Clemson, S.C.

Professional Affiliations

Registered Professional Engineer (Oklahoma Number 13499)
American Institute of Chemical Engineers
American Chemical Society
American Society for Engineering Education
Certified Professional Chemist, A.I.C. (1975)

Honorary Affiliations

Sigma Xi
Tau Beta Pi
Phi Kappa Phi
Who's Who in the South and Southwest, 1981
Outstanding Young Men of America, 1983

Experience Record

1971-1975 Texidyne, Inc., Clemson, S.C., Staff Chemist. Responsible for routine and specialized chemical analyses for water, wastewater, solid wastes, and air pollution testing. Experience in gas chromatography, atomic absorption, microbiological testing.

1975-1978 Texidyne, Inc., Clemson, S.C., Part-time Consultant. Responsible for overall management of laboratory facilities and some wastewater engineering studies. Also ran incinerator performance studies.

1976-1977 Clemson University, Clemson, S.C., Chief Analyst on airborne fluoride monitoring project in Chemical Engineering Department, performed for Owen-Corning Fiberglas Corp., Toledo, Ohio.

1978-1982 The University of Tulsa, Tulsa, OK., Assistant Professor of Chemical Engineering and Associate Director, University of Tulsa Environmental Protection Projects (UTEPP) Program. Normal teaching duties; research centered on specialized petroleum refinery problems of water and solid wastes.

1982-1983 The University of Tulsa, Tulsa, OK., Associate Professor of Chemical Engineering and Director of UTEPP Program. Normal teaching duties; researched and wrote five monographs on environmental areas; including, incineration, flotation, gravity separation, screening/sedimentation, and equalization.

1983-Date Engineering-Science, Senior Engineer. Responsible for a wide variety of waste treatment, chemical process, resource recovery, energy, incineration and air pollution control activities for industrial, governmental and local municipal clients. Recent activities include incineration evaluation for a toxic chemical disposal facility to be operated by the U.S. Army on Johnston Atoll, investigation of the breaking of oil/water emulsions from an industrial process discharge, analytical verification of oil residues in contaminated ground water at a hazardous waste disposal site and evaluation of alternative treatment technologies for a new pharmaceutical production facility including vapor re-compression evaporation, incineration, biological oxidation and various air pollution control systems. Particularly strong technical areas include waste treatment chemistry, incineration, analytical trouble-shooting, R&D and resource recovery technologies including energy recovery.

Publications

Snider, E.H., and J.J. Porter: Ozone Destruction of Selected Dyes in Wastewater, Am Dyestuff Rep., 63 (8), 36-48, 1974.

Porter, J.J., and E.H. Snider: Thirty Day Biodegradability of Textile Chemicals and Dyes, Book of Papers of 1974 National Technical Conference of AATCC, 427-436 (1974).

Snider, E.H., and J.J. Porter: Ozone Treatment of Dye Waste, J. Water Pollut. Control Fed., 46, 886-894, 1974.

Porter, J.J., and E.H. Snider: Long Term Biodegradability of Textile Chemicals, J. Water Pollut. Control Fed., 48, 2198-2210, 1976.

Snider, E.H., and J.J. Porter: Comparison of Atmospheric Hydrocarbon Levels with Air Quality Standards, Am. Dyestuff Ref., 65 (8), 22-31, 1976.

Snider, E.H.: Organization of a Functional Chemical Engineering Library; Chem. Eng. Ed., 11 (1), 44-48, 1977.

Snider, E.H., and F.C. Alley: Kinetics of the Chlorination of Biphenyl Under Conditions of Waste Treatment Processes, Env. Sci. Tech., 13, 1244-1248 (1979).

Snider, E.H. and F.C. Alley: Kinetics of Biphenyl Chlorination in Aqueous Systems in the Neutral and Alkaline pH Ranges, Chapter 21 in Proceedings Third Conference on Chlorination, Ann Arbor Science Publishers, Inc., Ann Arbor, MI, 1980.

Sublette, K.L., E.H. Snider, and N.D. Sylvester: Powdered Activated Carbon Enhancement of the Activated Sludge Process: A Study of the Mechanisms, in Proceedings of the Eighth Annual Water and Wastewater Equipment Manufacturers Association (WWEMA) Industrial Pollution Conference, pp. 351-369, 1980.

Snider, E.H.: "Chemical Engineering Laboratory Courses at The University of Tulsa: Improving the Communication of Technical Results," in Proceedings of the Fifteenth Midwest Section Conference of ASEE, pp. IIB28-IIB35, 1980.

Snider, E.H.: "Chemical Engineering Laboratory Experiment: Mass Transfer Tray Hydraulics," in Proceedings of 16th Midwest Section Conference of ASEE, pp. II A-9 - II A-16, 1981.

Snider, E.H.: "Chemical Engineering Laboratory Experiment: Mass Transfer Tray Hydraulics," in Proceedings of 1981 ASEE National Meeting, Vol. II, pp. 360-363, 1981.

Snider, E.H. and F.S. Manning: "A Survey of Pollutant Emission Levels in Wastewaters and Residuals from the Petroleum Refining Industry," Env. International, Vol. 7, pp. 237-258, 1982.

Sublette, K.L., E.H. Snider and N.D. Sylvester: "A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment," Water Research, 16, 1075-1082 (1982).

Books; Monographs; Chapters

Manning, F.S., and E.H. Snider; "Equalization," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Ford, D.L., F.S. Manning, and E.H. Snider: "Flotation," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Manning, F.S., and E.H. Snider; "Oil and Grease Removal by Gravity," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Manning, F.S., and E.H. Snider; "Incineration: Wastewater Treatment Applications," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Manning, F.S., E.H. Snider, and E.L. Thackston: "Screening and Sedimentation," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Short Courses and Presentations

January 1974	Presentation of paper, "Comparison of Existing Air Pollution Levels with Standards," Third Annual Conference on Textile Wastewater and Air Pollution Control, Hilton Head Island, S.C.
May 1974	Presentation of paper, "Thirty Day Biodegradability of Textile Chemicals and Dyes," 1974 Annual Technical Conference of American Association of Textile Chemists and Colorists, New Orleans, LA.
June 1977	Presentation, "Air Pollution Instrumentation"; Short Course on Industrial Pollution Control, Clemson University, Clemson, S.C.
June 1977	Presentation, "Industrial Sludge Treatment and Disposal"; Short Course on Industrial Pollution Control, Clemson University, Clemson, S.C.
October 1977	Presentation, "A Kinetic Study of the Reactions of Biphenyl and Chlorine in Water to Form Chlorobiphenyls"; Chem. Eng. Dept. seminar, Clemson University, Clemson, S.C.
January 1978	Presentation of paper, "Carbon Adsorption for Removal of Gaseous Pollutants," 1978 Technical Meeting of American Association of Textile Chemists and Colorists, New York, N.Y.
January 1978	Presentation of paper, "Carbon Adsorption for Removal of Gaseous Pollutants," The University of Tulsa, Tulsa, OK.
June 1980	Presentation of paper, "Powdered Activated Carbon Enhancement of the Activated Sludge Process," Eighth Annual Meeting of the Water and Wastewater Treatment Manufacturers Association, Austin, TX.

June 1981	Presentation of paper, "The Valve Tray Column: An Experiment in Tray Hydraulics," Annual National Meeting of Am. Soc. for Engr. Education, Los Angeles, CA.
March 1982	Presentation of paper, "PAC Enhancement of the Activated Sludge Process," Chem. Engr. Dept. seminar series, University of Oklahoma, Norman, OK.

APPENDIX B

LIST OF INTERVIEWEES AND OUTSIDE AGENCY CONTACTS

APPENDIX B

TABLE B.1

LIST OF INTERVIEWEES

	Most Recent Position	Years of Service
1.	Contact Officer, Defense Contract Administration Services, Plant Represenatives Office	5
2.	Enviromental Coordinator, Rockwell International	4
3.	Plant Engineer/Environmental, McDonnell Douglas	4
4.	Section Manager, Plant Engineering/Control, McDonnell Douglas	32
5.	Supervisor, Construction, Heating and Air Conditioning, McDonnell Douglas	15
6.	Branch Manager, Plant Engineering, McDonnell Douglas	19
7.	Plant Engineer, McDonnell Douglas	27
8.	Chemistry Laboratory Supervisor, McDonnell Douglas	25
9.	Leadman, Transportation Department, McDonnell Douglas	30
10.	Leadman, Utility Maintenance, McDonnell Douglas	32
11.	Leadman, Pressure Test Maintenance, McDonnell Douglas	32
12.	Manager of Warehousing, McDonnell Douglas	33
13.	Branch Manager, Safety and Medical, McDonnell Douglas	2
14.	Manager of External Affairs, McDonnell Douglas	32
15.	Foreman, Building and Grounds, McDonnell Douglas	32
16.	Manager, Plant Engineering and Maintenance	32

APPENDIX B
TABLE B.1
LIST OF INTERVIEWEES
(Continued)

	Most Recent Position	Years of Service
17.	Plant Engineer, McDonnell Douglas	30
18.	Operator, Fuels Management, McDonnell Douglas	33
19.	Leadman, Salvage, McDonnell Douglas	28
20.	Fireman, McDonnell Douglas	19
21.	Plumber, McDonnell Douglas	21
22.	Plumber, McDonnell Douglas	29
23.	Driver, Transportation Department, McDonnell Douglas	31
24.	Safety Administrator, Rockwell International	21
25.	Technical Staff Member, Rockwell International	10 - Douglas 21 - Rockwell
26.	Paint & Process, Staff Member Rockwell Interantional	20
27.	Chief of Protective Services, Rockwell International	21
28.	Senior Facilities Project Engineer, Rockwell International	10
29	Supervisor Facilities Design Engineering, Rockwell International	4
30.	Maintenance Supervisor, Rockwell International	20
31.	Assistant Supervisor Warehouse Conservation, Surplus, Rockwell International	4
32.	Industrial Wastewater Treatment Plant Operator, Rockwell	13
33.	IWTP Supervisor, Rockwell International	20

APPENDIX B

TABLE B.1

LIST OF INTERVIEWEES

(Continued)

	Most Recent Position	Period of Service
34.	Maintenance Supervisor, Rockwell International	19
35.	Manager Plant Services Maintenance, Rockwell International	19
36.	Salvage Sales Staff Member, Rockwell International	20

TABLE B.2

OUTSIDE AGENCY CONTACTS

1. Tulsa City County Health Department, Mike Wright, Environmental Specialist, Water Quality, Solid and Industrial Waste, (918)744-1000

2. Oklahoma Water Resources Board, Rob Simms, Environmental Specialist, (918)747-6841

3. Oklahoma Water Resources Board, Donna Metcalf, Environmental Specialist, (405)271-2555

4. Oklahoma State Department of Health, Ken Burns, Environmental Specialist Supervisor, (405)271-5600

5. U.S. Army Corps of Engineers, Frank Shimkees, Engineering Technician, (918)581-7395

6. U.S. Geological Survey, WRD, Leland D. Hauth, Hydrologist, (405)231-4256

7. U.S. Environmental Protection Agency, Region VI, Dallas, Texas. James Highland, Federal Facilities Compliance Officer, (214) 767-2724

APPENDIX C

SUPPLEMENTAL PLANT FINDINGS INFORMATION

Table C.1 Oil and Fuel Storage Tank List

C

TABLE C.1

OIL AND FUEL STORAGE TANK LIST

FUEL FARM

Number of Tanks	-	11
Capacity	-	25,000 Gallons each
Type of Storage	-	Subsurface
Contents	-	Tanks #1 thru 9 - Jet fuel Tanks #10 and 11 - Soltrol

GAS STATION

Number of Tanks	-	2
Capacity	-	6,000 Gallons (Regular) 5,000 Gallons (Unleaded)
Type of Storage	-	Subsurface
Contents	-	Gasoline

BUILDING NO. 17 (East of)

Number of Tanks	-	1
Capacity	-	6,000 Gallons
Type of Storage	-	Subsurface
Contents	-	Waste Oil

BUILDING NO. 7 (South of)

Number of Tanks	-	2
Capacity	-	6,000 Gallons each
Type of Storage	-	Subsurface
Contents	-	No. 2 Fuel Oil

BUILDING NO. 18 (East of)

Number of Tanks	-	2
Capacity	-	6,000 Gallons each
Type of Storage	-	Subsurface
Contents	-	Gasoline

APPENDIX D

MASTER LISTS OF SHOPS

TABLE D.1
MASTER LIST OF MCDONNELL DOUGLAS SHOPS

Shop Name	Department Number	Handles Hazardous Material	Generates Hazardous Waste	Current Treatment Storage & Disposal Method
Air Condition Maintenance	702	No	No	NA
Automotive Maintenance	707	Yes	Yes	Contract Recylcer
Aviation Fuel	169	Yes	Yes	Contract Recycler, Fire Protection Training Area
Battery Shop	702	Yes	No	NA
Building & Equipment Mechanic	704	No	No	NA
Building Plumbing	705	No	No	NA
Chemical Mill	451	Yes	Yes	Contract Disposal
DC-8 Modification	599	Yes	Yes	Contract Disposal
DC-10 Assembly	545	Yes	No	NA
Egress Shop	587	Yes	No	NA
Electrical Maintenance	702	Yes	Yes	PCB Storage
Electronics Building	559	Yes	Yes	Industrial Waste Treatment Plant
F-4 Modifications	596	Yes	No	NA
F-15 Assembly	864	No	No	NA
F-18 External Stores	564	Yes	Yes	IWTP & Contract Disposal
Heat Treatment	452	No	No	NA
Hot Form Area	403	No	No	NA
Metal Bond	497	Yes	Yes	IWTP
Paint Hangar	594	Yes	Yes	Sanitary Sewer/ Contract Disposal
Plastics and Fiberglass	498	Yes	No	NA
Harpoon Program	560	Yes	No	NA
Machine Shop	406	Yes	No	NA
Nondestructive Testing	840	Yes	Yes	Contract Disposal
Paint Stores	169	Yes	No	NA
Photography	265	Yes	Yes	Sanitary Sewer Silver Recovery
Boiler Room	T708	Yes	Yes	Contract Recycler, Contract Disposal, Sanitary Sewer
Machine Tool Overhaul	703	Yes	Yes	Contract Recycler Sanitary Sewer
Plumbing Maintenance	705	Yes	No	NA
X-Ray Laboratory	840	Yes	Yes	Sanitary Sewer

TABLE D.1
MASTER LIST OF MCDONNELL DOUGLAS SHOPS
(Continued)

Shop Name	Department Number	Handles Hazardous Material	Generates Hazardous Waste	Current Treatment Storage & Disposal Method
Tubing Shop	556	Yes	No	NA
Hydraulics	556	Yes	Yes	Contract Disposal
Aluminum Heat Treatment and Process	T452	Yes	Yes	IWTP/Contract Disposal
Maintenance Paint Booth	T704	Yes	Yes	Contract Disposal

TABLE D.2
MASTER LIST OF ROCKWELL INTERNATIONAL SHOPS

Shop Name	Department Number	Handles Hazardous Material	Generates Hazardous Waste	Current Treatment Storage & Disposal Method
General Administration	901	No	No	NA
Human Resources	902	No	No	NA
Financial Operations	904	No	No	NA
Program Control	905	No	No	NA
Contracts Administration	907	No	No	NA
Information Systems	916	No	No	NA
Publications	917	Yes	Yes	Sanitary Sewer
Human Resources Administration	920	No	No	NA
Industrial Security and Safety	921	No	No	NA
Communications Services	922	No	No	NA
Career Development	924	No	No	NA
Employee Relations	929	No	No	NA
Operations Control	930	No	No	NA
Detail Production Control	934	No	No	NA
Manufacturing Engineering	935	No	No	NA
Fabrication & Tool Inspection	943	No	No	NA
Quality Assurance Administration	944	No	No	NA
Quality Engineering and QA Labs	945	No	No	NA
Metrology Labs	948	No	No	NA
Program/Project Management	950	Yes	No	NA
Shipping & Transport	951	Yes	Yes	Contract Recycler
Warehouse	952	Yes	No	NA
Shipping	955	Yes	No	NA
Manufacturing Planning	956	No	No	NA
Production Order Control	957	No	No	NA
Numerical Control Program	958	No	No	NA
Operations Administration	960	No	No	NA
Machine Shop	961	Yes	Yes	Contract Disposal Recycle
Detail Fabrication	962	Yes	Yes	Contract Disposal Recycle
Composite Production Assembly	963	Yes	No	NA
Composite Bonding	964	Yes	No	NA
Bonding & Plastics	965	Yes	Yes	Contract Disposal

TABLE D.2
MASTER LIST OF ROCKWELL INTERNATIONAL SHOPS

Shop Name	Department Number	Handles Hazardous Material	Generates Hazardous Waste	Current Treatment Storage & Disposal Method
Paint and Processing	966	Yes	Yes	IWTP/Contract Disposal
Tool Cribs	969	Yes	No	NA
Visibility & Analysis	971	No	No	NA
Industrial Engineering	981	No	No	NA
Facilities Engineering	982	Yes	Yes	IWTP
Plant Services	986	Yes	Yes	Contract Disposal
Research & Engineering	990	No	No	NA
Project & Systems Engineering	991	No	No	NA
Structural & Mechanical System Design	992	No	No	NA
Material Review	993	No	No	NA
Technical Analysis	995	No	No	NA
Laboratories	996	Yes	Yes	Sanitary Sewer
Print Control	997	No	No	NA

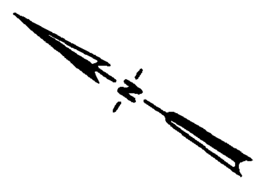
APPENDIX E

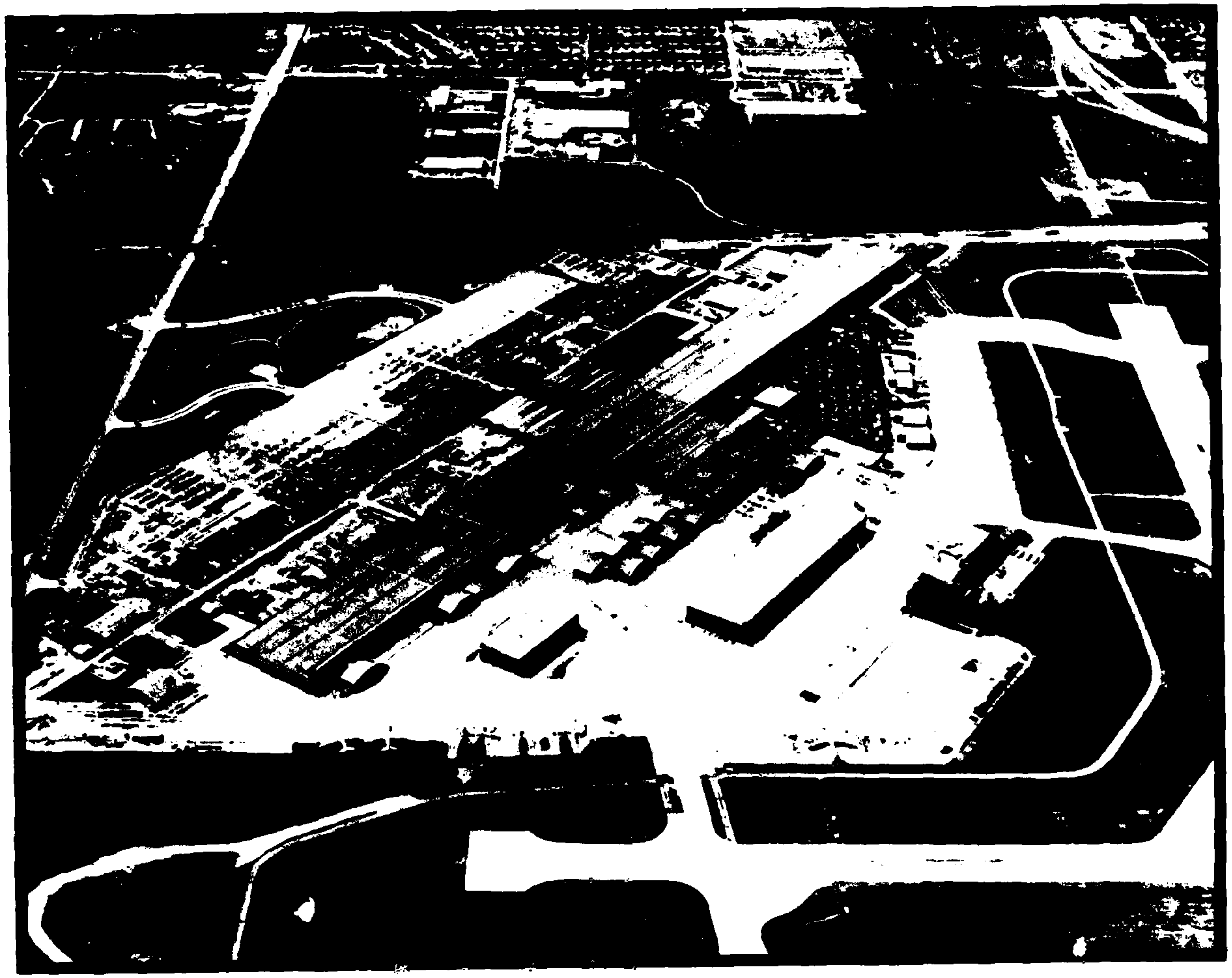
PHOTOGRAPHS

AERIAL PHOTO

USAF PLANT #3

YEAR 1962





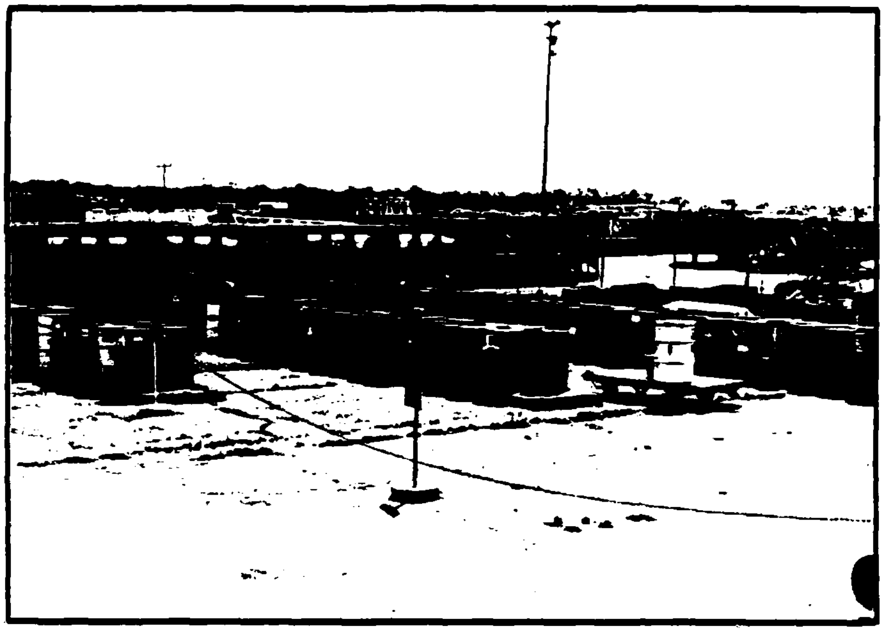
AERIAL PHOTO

USAF PLANT #3

YEAR 1983

USAF PLANT NO. 3

HAZARDOUS WASTE STORAGE SITE A

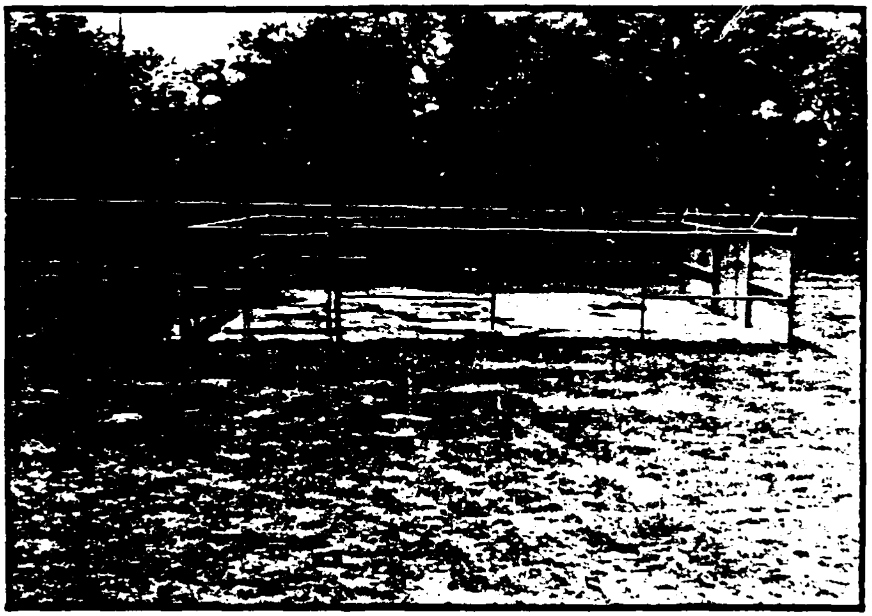


(Looking Northeast)

(Looking Northwest)

USAF PLANT NO. 3

FIRE PROTECTION TRAINING AREA
(Looking North)



LOW-LEVEL RADIOACTIVE WASTE BURIAL SITE
(Looking South)

USAF PLANT NO. 3

INDUSTRIAL WASTE DISPOSAL

SLUDGE LAGOON

(Looking East)

APPENDIX E

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX F

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with represenatives from USAF Occupational and Environmental Health Laboratory (OEHL), Air Force Engineering and Services Center (AFESC), Engineering-Science (ES) and CH2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering-Science, and CH2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of the IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Records Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence, 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

FIGURE 1

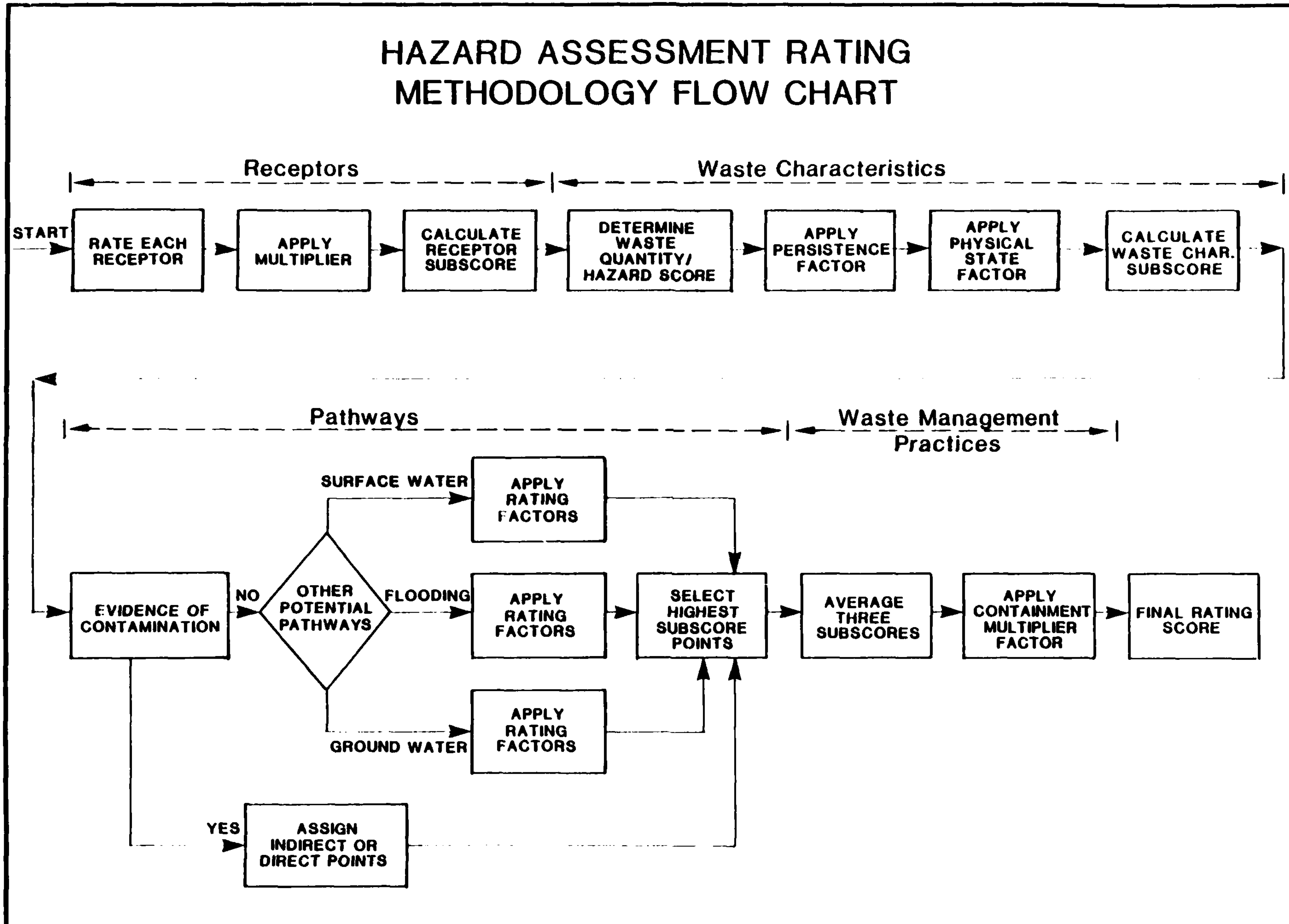

HAZARD ASSESSMENT RATING
METHODOLOGY FLOW CHART
Receptors
Waste Characteristics
START
RATE EACH RECEPTOR
APPLY MULTIPLIER
CALCULATE RECEPTOR SUBSCORE
DETERMINE WASTE QUANTITY/ HAZARD SCORE
APPLY PERSISTENCE FACTOR
APPLY PHYSICAL STATE FACTOR
CALCULATE WASTE CHAR. SUBSCORE
Pathways
Waste Management Practices
EVIDENCE OF CONTAMINATION
NO
OTHER POTENTIAL PATHWAYS
SURFACE WATER
FLOODING
GROUND WATER
APPLY RATING FACTORS
APPLY RATING FACTORS
APPLY RATING FACTORS
SELECT HIGHEST SUBSCORE POINTS
AVERAGE THREE SUBSCORES
APPLY CONTAINMENT MULTIPLIER FACTOR
FINAL RATING SCORE
YES
ASSIGN INDIRECT OR DIRECT POINTS

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE ______

LOCATION ______

DATE OF OPERATION OR OCCURRENCE ______

OWNER/OPERATOR ______

COMMENTS/DESCRIPTION ______

SITE RATED BY ______

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		
		Subtotals	______	______

Receptors subscore (100 X factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

FIGURE 2 (Continued)

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
Subtotals			______	______

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
Subtotals			______	______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ x ______ = ______

TABLE 1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1,000	6

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (<5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (>20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records.
- o Knowledge of types and quantities of wastes generated by shops and other areas on base.
- o Based on the above, a determination of the types and quantities of waste disposed of at the site.

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records.
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

Waste Hazard Rating
- o Wastes with the same hazard rating can be added
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8
B-2 POTENTIAL FOR FLOODING					
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

Rating Factor	0	1	2	3	Multiplier
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Fire Proection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

APPENDIX G

HAZARDOUS ASSESSMENT SITE RATING FORMS

TABLE OF CONTENTS

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Hazardous Waste Storage Site A
Location: South of Building 67
Date of Operation or Occurrence: 1964 - Present
Owner/Operator: McDonnell Douglas
Comments/Description: Fenced area, material stored on soil, some leakage

Site Rated by: McLeod, Snider, and Schroeder

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
Subtotals			73	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 41

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	41		
Waste Characteristics	60		
Pathways	48		
Total	149 divided by 3 =	50	Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

50 x 1.00 = 50

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Hazardous Waste Storage Site B
Location: South of Building 52
Date of Operation or Occurrence: 1976 - Present
Owner/Operator: McDonnell Douglas I Douglas
Comments/Description: Fenced area, material stored on soil, some leakage

Site Rated by: McLeod, Snider, and Schroeder

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
Subtotals			73	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 41

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		41	
Waste Characteristics		60	
Pathways		48	
Total	149	divided by 3 =	50 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

50 x 1.00 = \ 50 \
FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Hazardous Waste Storage Site C
Location: East of Building 64
Date of Operation or Occurrence: 1962 - Present
Owner/Operator: Operated by Rockwell International
Comments/Description: Fenced area, material stored on soil, some leakage

Site Rated by: McLeod, Snider, and Shroeder

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
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Subtotals			73	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 41

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
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3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		41
Waste Characteristics		60
Pathways		48
Total	149 divided by 3 =	50 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

50 x 1.00 = 50

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Hardfill Area
Location: North of Building 1
Date of Operation or Occurrence: 1952 - 1960's
Owner/Operator: McDonnell Douglas
Comments/Description: Closed site, graded, soil and vegetation cover, some burning occurred

Site Rated by: McLeod, Snider, and Schroeder

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	5	6	18
G. Ground water use of uppermost aquifer	1	[illegible]	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
Subtotals			73	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 41

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 2
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 1.00 = 50

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			60	108
Subscore (100 x factor score subtotal/maximum score subtotal)				56
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		41	
Waste Characteristics		50	
Pathways		48	
Total	139	divided by 3 =	46 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

46 x 1.00 = 46

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fire Protection Training Area
Location: East of east parking lot
Date of Operation or Occurrence: 1952 - Present
Owner/Operator: Operated by McDonnell Douglas
Comments/Description: depressed area, soil bottom, infrequent fire training exercises

Site Rated by: McLeod, Snider, and Schroeder

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
Subtotals			69	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 38

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.80 = 48

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.00 = 48

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		38
Waste Characteristics		48
Pathways		48
Total	134 divided by 3 =	45 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

45 x 1.00 = 45

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Low Level Radioactive Waste Disposal Area
Location: Southeast Corner of Site
Date of Operation or Occurrence: 1950's - 1960's
Owner/Operator: Operated by McDonnell Douglas
Comments/Description: Fenced site with signs

Site Rated by: McLeod, Snider, and Schroeder

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	1	6	6	18
Subtotals			69	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 38

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 0.50 = 30

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	1	1	1	3
Subscore (100 x factor score/3)				33
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		38	
Waste Characteristics		30	
Pathways		48	
Total	116 divided by 3 =		39 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

39 x 0.95 = 37 FINAL SCORE

APPENDIX H

REFERENCES

H

APPENDIX H

REFERENCES

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APPENDIX I

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

APPENDIX I

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ACID DESMUT: Strong acid solution generated during cleaning of metal parts.

ACID ETCH SOLUTION: Stong acid solution.

AF: Air Force.

AFESC: Air Force Engineering and Services Center.

AFFF: Aqueous Film Forming Foam, a fire extinguishing agent.

Ag: Chemical symbol for silver.

Al: Chemical symbol for aluminum.

ALKALINE CLEANER: Concentrated phosphate-free soap solution.

ALLUVIUM: Materials eroded, transported and deposited by streams.

ALLUVIAL FAN: A fan-shaped deposit formed by a stream either where it issues from a narrow mountain valley into a plain or broad valley, or where a tributary stream joins a main stream.

ALUMINUM CHEMICAL MILL SOLUTION: Strong alkaline solution.

ALUMINUM-SALT HEAT TREAT: Potassium and nitrate salts.

ANTICLINE: A fold in which layered strata are inclined down and away from the axes.

ARTESIAN: Ground water contained under hydrostatic pressure.

AQUICLUDE: Poorly permeable formation that impedes ground-water movement and does not yield to a well or spring.

AQUIFER: A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring.

AQUITARD: A geologic unit which impedes ground-water flow.

AROMATIC: Description of organic chemical compounds in which the carbon atoms are arranged into a ring with special electron stability associated. Aromatic compounds are often more reactive than non-aromatics.

AVGAS: Aviation Gasoline.

Ba: Chemical symbol for barium.

BIOACCUMULATE: Tendency of elements or compounds to accumulate or build up in the tissues of living organisms when they are exposed to these elements in their environments, e.g., heavy metals.

BIODEGRADABLE: The characteristic of a substance to be broken down from complex to simple compounds by microorganisms.

$CaCO_3$: Chemical symbol for calcium carbonate.

CADMIUM PLATING LIQUID WASTE: Alkaline cyanide solution.

CADMIUM PLATING SLUDGE: Alkaline cyanide-containing slidge.

Cd: Chemical symbol for cadmium.

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act.

CHEMICAL MILL SLUDGE: Acidic salts of titanium.

CHROMIC ACID ANODIZE WASTE: Strong acid solution.

CIRCA: About; used to indicate an approximate date.

CLOSURE: The completion of a set of rigidly defined functions for a hazardous waste facility no longer in operation.

CN: Chemical symbol for cyanide.

COD: Chemical Oxygen Demand, a measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water.

COE: Corps of Engineers.

CONFINED AQUIFER: An aquifer bounded above and below by impermeable strata or by geologic units of distinctly lower permeability than that of the aquifer itself.

CONFINING UNIT: An aquitard or other poorly permeable layer which restricts the movement of ground water.

CONTAMINATION: The degradation of natural water quality to the extent that its usefulness is impaired; there is no implication of any specific limits since the degree of permissible contamination depends upon the intended end use or uses of the water.

CONVERSION COATING WASTE: Acidic solution containing chromium.

COOLANT: An oil-water mixture used for cooling metal parts during forming.

Cr: Chemical symbol for chromium.

Cu: Chemical symbol for copper.

DCASPRO: Defense Contract Administration Services, Plant Representative's Office

DEIONIZATION REGENERATION WASTE: blended and neutralized caustic and acidic wastewaters generated.

DEIONIZATION RESINS: Plastic beads utilized in the deionization of water.

DEPOT MAINTENANCE: Major overhaul of equipment.

DIP: The angle at which a stratum is inclined from the horizontal.

DISPOSAL FACILITY: A facility or part of a facility at which hazardous waste is intentionally placed into or on land or water, and at which waste will remain after closure.

DISPOSAL OF HAZARDOUS WASTE: The discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground water.

DOD: Department of Defense.

DOWNGRADIENT: In the direction of decreasing hydraulic static head; the direction in which ground water flows.

DUMP: An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics; dumps are susceptible to open burning and are exposed to the elements, disease vectors and scavengers.

EFFLUENT: A liquid waste discharge from a manufacturing or treatment process, in its natural state, or partially or completely treated, that discharges into the environment.

EP: Extraction Procedure, the EPA's standard laboratory procedure for leachate generation.

EPA: U.S. Environmental Protection Agency.

EPHEMERAL AQUIFER: A water-bearing zone typically located near the surface which normally contains water seasonally.

EROSION: The wearing away of land surface by wind, water, or chemical processes.

ES: Engineering-Science, Inc.

FAA: Federal Aviation Administration.

FACILITY: Any land and appurtenances thereon and thereto used for the treatment, storage and/or disposal of hazardous wastes.

FAULT: A fracture in rock along which the adjacent rock surfaces are differentially displaced.

Fe: Chemical symbol for iron.

FLOOD PLAIN: The lowland and relatively flat areas adjoining inland and coastal areas of the mainland and off-shore islands, including, at a minimum, areas subject to a one percent or greater chance of flooding in any given year.

FLOW PATH: The direction or movement of ground water as governed principally by the hydraulic gradient.

FPTA: Fire Protection Training Area.

GC/MS: Gas chromatograph/mass spectrophotometer, a laboratory procedure for identifying unknown organic compounds.

GLACIAL TILL: Unsorted and unstratified drift consisting of clay, sand, gravel and boulders which is deposited by or underneath a glacier.

GROUND WATER: Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure.

GROUND WATER RESERVOIR: The earth materials and the intervening open spaces that contain ground water.

HALOGEN: The class of chemical elements including fluorine, chlorine, bromine, and iodine.

HARDFILL: Disposal sites receiving construction debris, wood, miscellaneous spoil material.

HARM: Hazard Assessment Rating Methodology.

HAZARDOUS SUBSTANCE: Under CERCLA, the definition of hazardous substance includes:

1. All substances regulated under Paragraphs 311 and 307 of the Clean Water Act (except oil);

2. All substances regulated under Paragraph 3001 of the Solid Waste Disposal Act;

3. All substances regulated under Paragraph 112 of the Clean Air Act;

4. All substances which the Administrator of EPA has acted against under Paragraph 7 of the Toxic Substance Control Act;

5. Additional substances designated under Paragraph 102 of the Superfund bill.

HAZARDOUS WASTE: As defined in RCRA, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

HAZARDOUS WASTE GENERATION: The act or process of producing a hazardous wast .

HEAVY METALS: Metallic elements, including the transition series, which include many elements required for plant and animal nutrition in trace concentrations but which become toxic at higher concentrations.

Hg: Chemical symbol for mercury.

HWMF: Hazardous Waste Management Facility.

HYDROCARBONS: Organic chemical compounds composed of hydrogen and carbon atoms chemically bonded. Hydrocarbons may be straight chain, cyclic, branched chain, aromatic, or polycyclic, dependi..g upon arrangement of carbon atoms. Halogenated hydrocarbons are hydrocarbons in which one or more hydrogen atoms has been replaced by a halogen atom.

INCOMPATIBLE WASTE: A waste unsuitable for commingling with another waste or material because the commingling might result in generation of extreme heat or pressure, explosion or violent reaction, fire, formation of substances which are shock sensitive, friction sensitive, or otherwise have the potential for reacting violently, formation of toxic dusts, mists, fumes, and gases, volatilization of ignitable or toxic chemicals due to heat generation in such a manner that the likelihood of contamination of ground water or escape of the substance into the environment is increased, any other reaction which might result in not meeting the air, human health, and environmental standards.

INCONEL CHEMICAL MILL ACID: Strong acid solution.

INFILTRATION: The movement of water through the soil surface into the ground.

IRP: Installation Restoration Program.

ISOPACH: Graphic presentation of geologic data, including lines of equal unit thickness that may be based on confirmed (drill hole) data or indirect geophysical measurement.

IWTF: Industrial Waste Treatment Facility

JP-4: Jet Propulsion Fuel Number Four, military jet fuel.

JET-50: Jet Propulsion Fuel Number 50, commercial jet fuel.

LEACHATE: A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water.

LEACHING: The process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

LENTICULAR: A bed or rock stratum or body that is lens-shaped.

LINER: A continuous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate.

LIQUID CHEMICAL MILL WASTE: Strong acid solution.

LITHOLOGY: The description of the physical character of a rock.

LOESS: An essentially unconsolidated unstratified calcareous silt; commonly homogeneous, permeable and buff to gray in color.

LYSIMETER: A vacuum operated sampling device used for extracting pore water samples at various depths within the unsaturated zone.

METAL BOND ETCH: Acid solution.

MGD: Million gallons per day.

MD: McDonnell Douglas

MDT: McDonnell Douglas Tulsa

Mn: Chemical symbol for manganese.

MONITORING WELL: A well used to measure ground-water levels and to obtain samples.

MORAINE: An accumulation of glacial drift deposited chiefly by direct glacial action and possessing initial constructional form independent of the floor beneath it.

MSL: Mean Sea Level.

MWR: Morale, Welfare and Recreation.

NCO: Non-commissioned Officer.

NCOIC: Non-commissioned Officer In-Charge.

NDI: Non-destructive inspection.

NET PRECIPITATION: The amount of annual precipitation minus annual evaporation.

NGVD: National Geodetic Vertical Datum of 1929.

Ni: Chemical symbol for nickel.

NOAA: National Oceanic and Atmospheric Administration

NPDES: National Pollutant Discharge Elimination System.

OEHL: Occupational and Environmental Health Laboratory.

ORGANIC: Being, containing or relating to carbon compounds, especially in which hydrogen is attached to carbon.

O&G: Symbols for oil and grease.

PAINT BOOTH CLEANING WASTE: Dried paint from walls and floor, and sludge from waterfall sump.

PAINT BOOTH EFFLUENT: Water from waterfall sump.

PAINT STRIPPING SLUDGE: Heavy sludge made up of paint flakes with entrained paint stripper and water.

PAINT STRIPPING WASTE LIQUID: Water containing toxic paint stripper and paint flakes.

Pb: Chemical symbol for lead.

PCB: Polychlorinated Biphenyl; liquids used as a dielectrics in electrical equipment.

PERCOLATION: Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.

PERMEABILITY: The capacity of a porous rock, soil or sediment for transmitting a fluid without damage to the structure of the medium.

PERSISTENCE: As applied to chemicals, those which are very stable and remain in the environment in their original form for an extended period of time.

pH: Negative logarithm of hydrogen ion concentration.

POLLUTANT: Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose.

POLYCYCLIC COMPOUND: All compounds in which carbon atoms are arranged into two or more rings, usually aromatic in nature.

POTENTIALLY ACTIVE FAULT: A fault along which movement has occurred within the last 25-million years.

POTENTIOMETRIC SURFACE: The imaginery surface to which water in an artesian aquifer would rise in tightly screened wells penetrating it.

PPB: Parts per billion by weight.

PPM: Parts per million by weight.

PRECIPITATION: Rainfall.

QUATERNARY MATERIALS: The second period of the Cenozoic geologic era, following the Tertiary, and including the last 2-3 million years.

RCRA: Resource Conservation and Recovery Act.

RECEPTORS: The potential impact group or resource for a waste contamination source.

RECHARGE AREA: A surface area in which surface water or precipitation percolates through the unsaturated zone and eventually reaches the zone of saturation. Recharge areas may be natural or manmade.

RECHARGE: The addition of water to the ground-water system by natural or artificial processes.

RI: Rockwell International

RIT: Rockwell International Tulsa

SANITARY LANDFILL: A land disposal site using an engineered method of disposing solid wastes on land in a way that minimizes environmental hazards.

SATURATED ZONE: That part of the earth's crust in which all voids are filled with water.

SAX'S TOXICITY: A rating method for evaluating the toxicity of chemical materials.

SCALE CONDITIONER SLUDGE: Sodium carbonate sludge.

SCALE CONDITIONER WASTE: Strong caustic solution.

SCS: U.S. Department of Agriculture Soil Conservation Service.

SEISMICITY: Pertaining to earthquakes or earth vibrations.

SLUDGE: Any garbage, refuse, or slude from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal

Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SOLTROL: A solvent used for cleaning aircraft fuel tanks.

SPILL: Any unplanned release or discharge of a hazardous waste onto or into the air, land, or water.

SPOT WELD ETCH WASTE: Strong acid solution.

STORAGE OF HAZARDOUS WASTE: Containment, either on a temporary basis or for a longer period, in such a manner as not to constitute disposal of such hazardous waste.

SULFURIC ACID ANODIZE WASTE: Strong acid solution.

TCE: Trichloroethylene.

TDS: Total Dissolved Solids, a water quality parameter.

TITANIUM CHEMICAL MILL: Strong acid solution.

TITANIUM PICKLE: Strong acid solution.

TOC: Total Organic Carbon.

TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.

TRANSMISSIVITY: The rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient.

TREATMENT OF HAZARDOUS WASTE: Any method, technique, or process including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous.

TSD: Treatment, storage or disposal.

UPGRADIENT: In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of ground water.

USAF: United States Air Force.

USDA: United States Department of Agriculture.

USFWS: United States Fish and Wildlife Service.

USGS: United States Geological Survey.

WASTE WIRE ETCHANT: Strong acid solution.

WATER TABLE: Surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere.

Zn: Chemical symbol for zinc.

APPENDIX J

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SOURCES

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APPENDIX J

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SOURCES

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